NATIONAL PETROLEUM NEWS

December 1, 1943

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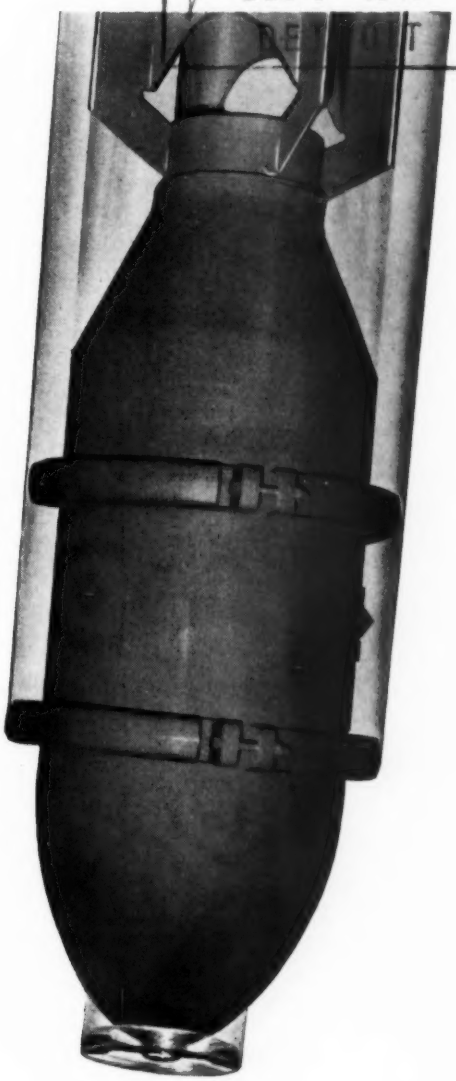
DETROIT

"To Herr Hitler . . . from me!"



★ How would you like to have that pointed message on a blockbuster, headed for Berlin or Berchtesgaden?

You can do it with the pen right there on your desk . . . by a memo to someone in your organization . . . an order saying, "check up on all obsolete equipment that we can scrap to aid the war effort."

True, you already may have junked some equipment. But the call for scrap increases. So, now, it is time to take another look. Time to put the finger on idle equipment in every branch of the industry . . . equipment that will not be efficient or profitable in operation when war is done.

For example, consider the fact that there are from four to five tons of potential iron and steel for war in every closed service station. That's enough scrap metal for 25 blockbusters . . . enough to blast heavily at Berlin or to blow Berchtesgaden off the map!

So, take another look. Scrap any and all equipment which peace will antiquate. Take that pen now and write the memo which will put your personal message on that blockbuster . . .

" . . . to Herr Hitler, from me!"

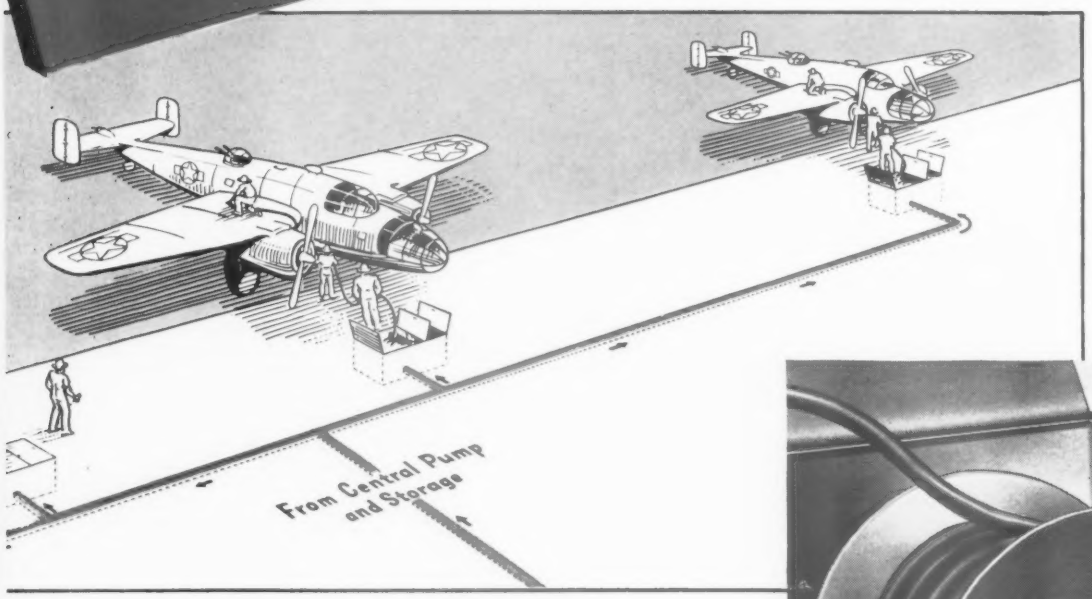
Scrap OBSOLETE EQUIPMENT TO HELP WIN THE Big Scrap

TODAY . . . TOMORROW . . . AND UNTIL THE WAR IS WON

One of a series of advertisements sponsored by equipment manufacturers and oil companies as a contribution to the national war effort.

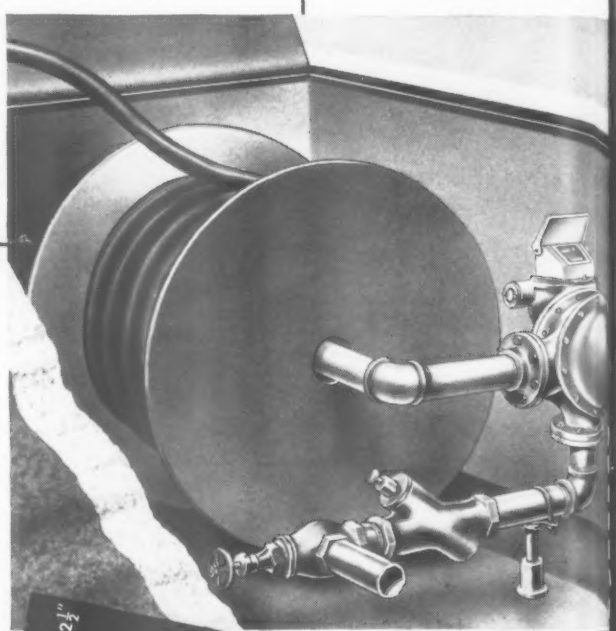
PITTSBURGH ROTOCYCLE METERS

standard equipment in the new *Shields Harper* AIRPORT FUELING PITS



LEFT: Sketch showing applicat of a multiple installation of Shields Harper airport fueling pit

BELOW: Cutaway view showing one end of pit



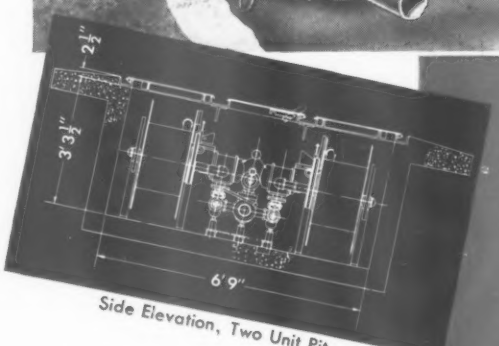
A Compact, Efficient System For Accurately Fueling Aircraft

THE Pittsburgh Equitable Meter Company is proud of the part played by Rotocycle Meters in making possible the 100-gallon-per-minute efficiency and the absolute accuracy of Shields Harper Fueling Pits.

This speed and this accuracy are two of the principal reasons why military and commercial airports all over America are choosing these modern fueling units.

Shields Harper pits combine, in one compact assembly, every element needed to strain, measure and deliver gasoline, including Rotocycle meters, control valves, shock absorbers, strainers and hose reels. To install a complete Shields Harper unit in a concrete pit, it is only necessary to connect the operating assembly with the hose reels—a mere matter of minutes.

For further information about Shields Harper Fueling Pits, we suggest that you write direct to the makers, Shields Harper, at 1212 Jackson St., Oakland 12, Calif.



Side Elevation, Two Unit Pit

PITTSBURGH EQUITABLE METER COMPANY

BOSTON · BROOKLYN · BUFFALO · CHICAGO · COLUMBIA · HOUSTON · KANSAS CITY

MERCO NORDSTROM VALVE COMPANY
Main Offices, Pittsburgh, Pa.

NATIONAL METER DIVISION, Brooklyn, N. Y.

LOS ANGELES · MEMPHIS · NEW YORK · PITTSBURGH · SAN FRANCISCO · SEATTLE · TULSA

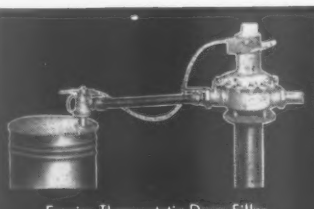
BACK THE ATTACK—BUY WAR BONDS

There's A Pittsburgh-National Meter for Every Type of Service

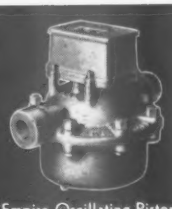
Pittsburgh Rotocycle for Bulk Plants, Tank Trucks

Pittsburgh Rotocycle for Pipe Line Service

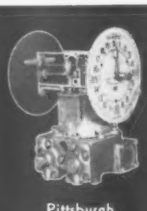
Empire Streamline Oscillating Piston for Bulk Plants



Empire Thermostatic Drum Filler for Filling Containers with Petroleum Products



Empire Oscillating Piston for Refinery and Industrial Services



Pittsburgh Reciprocating Piston for Service Station Pumps

Pittsburgh Disc for General Ser

MANUFACTURERS OF THE MOST COMPLETE LINE OF PETROLEUM METERS IN THE WOR

Not Complete!

This drum is not complete, even though it was built by one of the oldest and best drum manufacturers in the business. It can be filled with aviation gasoline and it can be emptied, but it can *not* be shipped. It does not have a closure.

MECHANICS OF THE VISEGRIP

The VISEGRIP flange, coined from 10 gauge steel, is imbedded permanently in the drum metal as the cone-shaped and serrated skirt of the flange is forced outward in a flattening toggle action. The cross section shows the flange in place, ready to receive the plug.

The VISEGRIP flange does not use either gasket or sealing compound. It is an integral and leakproof part of the drum . . . the drum is a part of the closure.

It is a simple fact that drums cannot be tighter than their closures. Indeed, the closures can be the tightest and strongest parts of the drums if they are selected for mechanical features that develop high sealing power.

Assured conservation and protection are built into drums that have VISEGRIP Closures. The drums are sealed by clamping the drum metal itself between flange and plug, in a tenacious vise grip. The strongest and most leakproof part of these drums are the VISEGRIP Closures.

Every drum manufacturer and many can companies in the United States are equipped with Rieke dies and stocks of VISEGRIP fittings. They will build VISEGRIP Closures into the drums and containers on your orders.

A copy of "VISEGRIP Drum Closures", our new full-sized catalogue, is available upon request. It is conveniently arranged for reference and filing.

VISEGRIP CLOSURES ***developed and produced by***

RIEKE METAL PRODUCTS CORPORATION

AUBURN, INDIANA **NEW YORK, N. Y.**

J. P. Patterson . . .

District 1 Transportation Boss

AFTER a 40-year business career with just two companies, J. P. Patterson recently has found what he terms his biggest job—director of the transportation division of PAW District 1. He calls it his biggest job because he is seeing team work where only unbridled competition existed before; he is helping to bring a new idea to the petroleum industry—co-operation. "As a government man," he says, "I hold a big stick, but I'm most interested in seeing how all us fellows get together without the need to use that stick. We've all come to realize that we have the same job to do, and we're pulling together to do it."

Mr. Patterson was born in New York City Sept. 26, 1889, only 6 blocks away from the office he now occupies. He received his grade schooling and first 2 years of high school education in the city, then he left school to go to work. He took a job as errand boy with a wholesale clothing firm, a "business connection", he explains, that fits right into the picture of all his later transportation work! He remained with this company 11 years, advancing to become its accountant and sales manager.

In 1916 Mr. Patterson took a year off for health, joined Mexican Petroleum Corp. in 1917. This was his first venture into the oil business and he jumped into the executive class at once: he started as assistant superintendent of the firm's Carteret, N. J., terminal. In this job—a wartime one then as is his job now—he had charge of fueling and transportation problems relating to convoys. He became superintendent of the plant in 1919, then general superintendent of the north terminals of Mexican Petroleum in 1925, taking on in 1926 the post of division sales manager of New Jersey while still handling terminals.

In 1933 he became general manager of terminals and marine transportation, and in 1935 moved over to Mexican Petroleum's parent company, Pan American Petroleum & Transport Co. where he was in charge of the construction of four tankers. He constructed two more tankers in 1938, and another in 1941. He is on leave now to PAW from Pan American.

Mr. Patterson came to PAW in August 1943 to head up the job of utilizing all types of transportation first for the war effort and second for civilian use. Previously he had served on a number of industry committees.

He regards as his most important job now the one of bringing industry to work together, not competitively.

NEW WARTIME EDITION

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This Week With NPN—

NOT OFTEN in the history of the Congress has a bill been forced out of committee by petition. But the Disney bill, providing for handling of oil prices by PAW and assuring a crude oil and products price increase if passed, was so petitioned out and will be voted in the House probably Dec. 13. More than the required 218 names were signed to the petition, and 71 of the signers were from states which produce no oil, or very little—like Utah, Missouri and Tennessee. Now, the bill's backers are mapping strategy on the forthcoming vote. Story on p. 10.

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A JUSTICE DEPARTMENT probe of charges that a move was on to squeeze oil cooperatives out of business has apparently satisfied the department that the charges have some foundation. Story on p. 9.

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THE WAR DEPARTMENT'S Canol project is indefensible on all counts, Missouri's Sen. Truman declared as his committee wound up hearings on the $130,000,000 oil venture in northern Canada. Army's Service Forces Chief Somervell is a witness invited to appear before the committee, but it may go ahead with an interim report without waiting for his testimony. Story on p. 11.

° ° °

A SPECIAL WRITER for NPN this week discusses river oil terminals and their future. He compares today's terminals with the wide-gauge, narrow-gauge rails in railroading's early history —a problem of lack of standardization brought about by the infancy, still, of river transportation of oil. For the future, he sees bigger and better terminals, with terminal and floating facilities more uniform to avoid loss of time in the operation of valuable equipment. His story begins on p. 28.

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NATIONAL PETROLEUM NEWS

December 1, 1943
Volume 35, Number 48

U. S. Boondoggling South of Border Killing Our Own Oil Business, Sen. Butler Says

NPN Staff Special

WASHINGTON—"Boondoggling" activities of the United States in South America were assailed this week by Senator Butler, (Neb.) in a blistering 176-page report in which he charged, among other things, that this country's "Good Neighbor" policy has forced Standard Oil out of the oil development picture in Argentina.

The report, filed with the Senate and also with the Truman and Byrd committees, represented the summation of findings made by the Nebraska legislator on his recent 20,000-mi. tour through Central and South America—a tour which convinced him that the U. S. has wasted $6,000,000,000 in loans, subsidies, grants and outright gifts to neighbor nations who now "laugh at us for being suckers."

Sen. Butler's report provoked an immediate storm of controversy, with the loudest protest coming from Vice President Wallace, who termed the document a "shocking slur" on our Latin American allies.

Says $50,000,000 Loaned Argentina

One of the loans criticized by Butler was for $50,000,000, which, he said, went to "the Axis-collaborating dictator government" of Argentina and enabled the Argentines to "take over all their own oil exploration, according to an official of the Standard Oil company, a United States firm which had already spent some $30,000,000 for this purpose and which, by this federal action, was forced out of the picture."

By way of illustrating the treatment he believes this country gets in return for its generosity, the Nebraskan cited the case of Mexico, which, he went on, "extorts an unjustifiable tribute from the United States in the form of heavy import taxes on aviation gasoline."

The gasoline Mexico taxes is gasoline used by U. S. planes to help protect Mexico, Sen. Butler charged. U. S. military and civilian agencies resent this "unfair toll," he asserted, their complaint being "that although we are using our airplanes to patrol and protect the coasts and country, Mexico forces us to pay heavy import taxes on the aviation gasoline necessary to operate such planes."

Attacks Spending Policy

Attacking the whole "Good Neighbor" spending policy of the U. S. Sen. Butler charged that, while nonessential expenditures in the U. S. have been drastically reduced or wiped out "as a part of the process of tightening our belts," the same cannot be said of Latin America.

"There," he continued, "a host of little WPA's, PWA's, FSA's and AAA's have been spawned by the New Deal during the past two years. It is clear that the New Deal program has been neither abolished nor adjourned, but merely transplanted to Latin America.

"Harry Hopkins, as chairman of the Munitions Assignment Board, gives away the Lease-Lend materials; Howard Hunter and David Saposs, two of Hopkins' former right-hand men in the WPA, have found new worlds to conquer in Latin America."

Sen. Hugh Butler
"$6,000,000,000 *Suckers*"

Streamlining of RPS 88 Being Rushed by OPA

NPN News Bureau

WASHINGTON — OPA's proposed break-up of cumbersome RPS 88, with its 141 amendments to date, into two new streamlined schedules will be up for final discussion with industry representatives at a meeting of PAW district marketing committees here Dec. 7.

The two new schedules, one for gasoline and fuel oil and the other for lubricants, greases and miscellaneous products, are virtually finished and will probably be issued shortly after the Dec. 7 meeting.

'B-2' and 'C-2' Coupons Valid

NPN News Bureau

WASHINGTON—"B-2" and "C-2" coupons will become valid Dec. 1, and will be worth 5 gal. of gasoline throughout the U. S., OPA announced Nov. 30.

The "B", "B-1", "C" and "C-1" coupons now in circulation remain valid for 3 gal. of gasoline in Districts 4 and 5 and for 2 gal. elsewhere.

"B-2" and "C-2" coupons must not be placed on the same gummed sheets on which "B", "B-1", "C" and "C-1" coupons are placed, OPA warned.

Co-op To Buy Refining Plant from National

Special to NPN

NORTH KANSAS CITY, Mo.—The Co-operative Refinery Assn., refining subsidiary of Consumers' Co-operative Assn., here, has agreed to purchase the Coffeyville, Kans., properties of National Refining Co., Cleveland, at a cost of more than $4,000,000. In announcing the purchase agreement Nov. 29, Howard A. Cowden, C.C.A. president, said that the cooperative plans to take over Jan. 1.

Meanwhile in Cleveland the National Refining Co. announced a stockholders meeting to be held Dec. 7, at which action on the Coffeyville plant sale and on a contract to sell 100 of the company's retail outlets to Shell Oil Co., Inc., will be taken.

The purchase agreement with C.R.A. covers a complete refinery with 13,500 b/d crude capacity, a furfural plant now under construction, 269 oil wells, 768 miles of gathering and trunk pipelines, 104,408 acres of undeveloped leases in Illinois, Kansas, Oklahoma, Texas and New Mexico. One well is drilling in Illinois now, and a further drilling program may be undertaken later. The co-operative plans to operate an aviation gasoline refinery now being constructed by DPC adjacent to the refinery, with a view to buying it after the war. Facilities also include a number of motor transports and substantial inventories.

The Co-operative Refinery Assn. now owns a 1500 bbl. refinery at Scottsbluff, Nebr., a 3400 bbl. refinery at Phillipsburg, Kans., and an interest in the 17,500 bbl. refinery at McPherson, Kans., which was purchased last July by five regional cooperative wholesales. C.C.A. provides 749 member associations in Kansas, Oklahoma, Colorado, Utah, Wyoming, North and South Dakota, Nebraska, Iowa and Missouri with farm and home supplies. Addition of the Coffeyville facilities could make C.R.A. one of the largest independent refineries in the U. S.

P. E. Lakin, vice-president in charge of marketing East of the Rockies for Shell Oil Co., Inc., Nov. 29 confirmed reported negotiations for "certain" of the Enarco service stations.

Sale of its Coffeyville plant and a hundred stations will leave National with a 9300 b/d refinery at Findlay, Ohio, 185 bulk and service stations wholly owned by the company and 300 other service station customers.

Is Military Preparing to Dump Huge Surplus?

First 'Fire Sale' Catalog Worries Suppliers

NPN News Bureau

CHICAGO—Is the military preparing for wholesale dumping of surplus equipment on the civilian market in anticipation of an early end of the war? Are manufacturers of oil marketing supplies, equipment and accessories, who have been contributing their all to the war effort, now going to be confronted with the gigantic task of survival in competition with vast surplus stocks of such war material suddenly thrown upon the open market at fire sale prices? Such action might force them to close their doors for from two to five years after the end of the war while peacetime consumption uses up the surpluses, manufacturers fear.

As evidence of this possible trend, the 830th Army Air Force Specialized Depot, 3300 Jackson Ave., Memphis, Tenn., is circularizing business firms over the country with an elaborate 32-page catalog filled with cuts and descriptions of a lengthy list of surplus items for sale. Heavy quality of good paper, the neat cuts, printing and general makeup of the catalog indicate that the Air Force depot anticipates strong competition from some unknown source in disposing of its surplus stocks.

Another One Coming

But the advance word is that the catalog from Memphis "can't hold a light" to the one that's coming out at Dayton, O., very soon. It will list thousands of items of every description, according to a man who said he saw a printer's proof.

Frontispiece of the book issued at Memphis asks, "Why this catalog?" and then proceeds to answer: "It is deemed essential to the successful prosecution of the war against shortages of needed materials that all property not immediately needed by the Army Air Forces be returned to industry for use directly or indirectly in manufacturing or other activities connected with the war effort. . . The property available for sale has resulted from termination of contracts for tactical reasons, changes affected by developments in theaters of operations and items rendered unnecessary due to progressive improvement in air strategy."

First item listed is rubber gasoline hose with or without couplings, "not suitable for use with aromatic fuel but can be used to dispense gasoline and other liquids used in industry. . . ." Sizes range from ¾ to 3½ in. inside diameter. Some is new and some used, but serviceable.

Air Compressors and Pumps

Portable air compressors manufactured by Brunner Co., Utica, N. Y.; fuel pumps by Chandler-Evans Corp., Detroit, and Dening Co., Salem, O.; gasoline meters by Buffalo Meter Co.; nozzles by Buckeye Brass Co.; drain cans and lubricators by the Dover Stamping & Manufacturing Co. and Phillips Pump & Tank Co., are other items listed. There are also 16 mm. film projectors and flying clothes, both fleece lined and electrically heated; shoes to match; Pratt-Whitney airplane engine parts; cabin heaters; ratchet lever jacks of 1½ ton capacity.

Turn a page or two of non-oil industry items and there are advertised Mazda electric lamps and reflectors and steel armored electric cable; fuel and oil hose nipples and other similar fittings. On pages 24, 25, 26 and 27 are a variety of hammers and sledges, miter boxes, saws, blades and knives; squares, levels, rulers and calipers; precision tools for plumbers, machinists and carpenters; drills of many sizes, ratchet screw drivers and pliers.

Skip a couple more pages and there are drums of lube oil, soda ash, turpentine; buckets of Whiz grease, lubricating grease, aluminum soap; typewriter and addressograph ribbons; brake linings, bolts, nuts, washers, hose clamps and clips.

Many of these things are items that the oil industry is starved for, due to the Army and Navy taking up all production for the past two years.

'Good Results', He Says

No prices or quantities on hand of the various items are given in the catalog, but Maj. Herman Lacy in direct charge of the surplus materials depot at Memphis, said on long distance phone that the catalog had brought good results as about two-thirds of the material he had on hand at the time the book was printed and passed out Nov. 1, had been sold. The depot still has about 22,000 gal. of lube oil in stock there and at Denver; also soft cup grease, graphite grease and aluminum soap. Additional supplies of the other items will also probably be coming in from time to time, he said although he had received no definite word to that effect.

Customer preference of the Air Force depot in sale of the surplus equipment, he gave as: (1) sales to other branches of the services; (2) sales to war contractors; (3) sales to air corps schools; (4) sales to others under Procurement Regulation No. 7—civilian firms with priorities. None of the equipment is being sold to resellers at the present time, he said. Sales are made to the highest bidder, and it is understood that three bidders are required in each case.

Checking other sources for possible dumping of surpluses, it was learned that auto accessory manufacturers are wondering what became of large stocks of auto parts and accessories stored in big warehouses, which equipment they said had suddenly disappeared. Story of this man was that the British were buying a great many more accessories than they have any use for on British-owned trucks.

At Blue Water, Tenn., depot there is reported to be a large stock of automobile frames and cross braces that the army does not know what to do with.

American Petroleum Institute lubricating committee is now at work on a program for the disposition of branded lubricating oils and greases. It is anticipated that manufacturers of these branded products will immediately re-purchase whatever becomes surplus for the Army and Navy.

A well known lubrication equipment manufacturer told NPN that as soon as any of their equipment gets on the surplus list, they intend to buy it back. He said they had been studying the prospective surplus problem for some time and that it's going to be a difficult thing to handle wisely.

The most difficult problem coming up, it was said, is likely to be surplus products of war-boom manufacturers, who will probably go out of business with completion of their war contracts and therefore will not be in position to repurchase surpluses.

PAW Advises Seeking Out 'Excess' Stockpiles

NPN News Bureau

WASHINGTON — Deputy PAW Davies advised refiners and contractors this week that they can speed up construction of aviation gasoline plants and special refining units by obtaining new material and equipment that has been declared "excess and available for war plants." He said there are "numerous" stockpiles of "excess" materials throughout the country and alert job personnel can pick up many items from these stocks.

Two of the larger stockpiles of these excess materials, in universal demand by refiners have been accumulated in Houston and Los Angeles but are only available to refiners building aviation gasoline plants, Mr. Davies said.

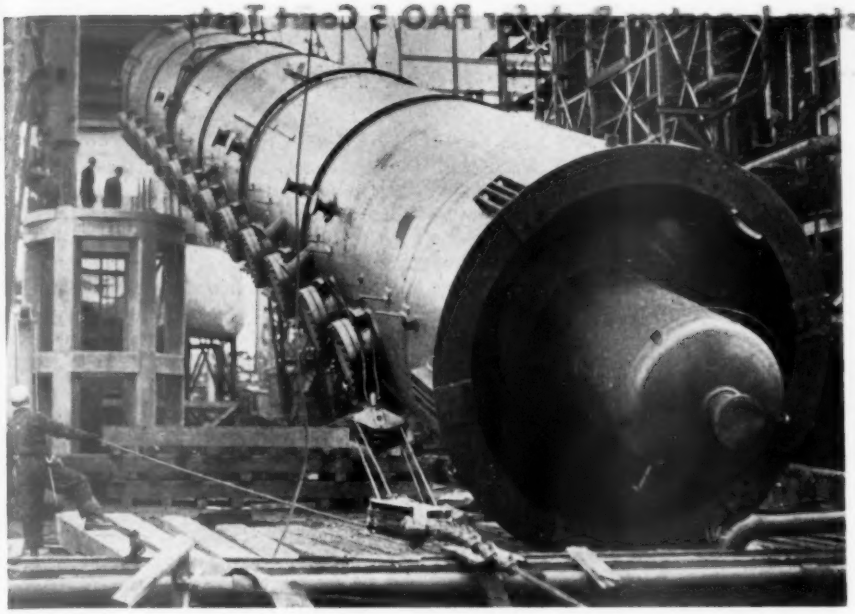
Refiners and contractors may obtain specific information on the location of the major "excess materials" stockpiles of interest to them by writing to Redistribution Section, Construction Division, PAW, Washington 25, D. C.

Still in effect, Mr. Davies reminded operators, is PAW's surplus redistribution program under which all oil operators itemize their surplus stocks of materials and file these lists in PAW district offices, which in turn are made available to operators in need of materials.

Texaco Forms Foreign Unit

NPN News Bureau

NEW YORK—The Texas Co. has consolidated its export sales and foreign producing departments into a foreign operations unit, C. E. Olmsted, Texas vice-president, announced Nov. 24. An executive division, with W. F. Moore and W. H. Borie as assistants to the vice-president, has been created. Harris T. Dodge, former assistant general manager of the export sales department, has been named manager of foreign sales.



Fractionating tower being swung into position at Sohio's new aviation plant

Newsmen See New 'Gas' Plant Being Built for Sohio

NPN News Bureau

CLEVELAND—In line with the government's new policy President W. T. Holliday, of Standard Oil Co. of Ohio, Monday conducted representatives of the press on an inspection of his company's new aviation gasoline plant.

Started in September, 1942, the new unit representing an investment of $8,500,000 is expected to be completed next spring, and will have a daily capacity of 100-octane gasoline sufficient to carry 100 four-motor bombers on a round trip from England to Berlin.

After lunch at Hotel Cleveland, during which Mr. Holliday explained the Houdry catalytic cracking process with which the new unit will be operated, newsmen were escorted to the construction scene. It is located on the site of the establishment of Standard Oil's first refinery in 1870.

E. B. Badger & Sons Co. are erecting the plant with some 600 workers on the job.

Considerable interest was shown by the visiting newsmen in the 220-feet "escape hatch" which, it was explained, will be for the purpose of expelling gases in case of emergency. Means of ignition is provided at the top of the giant tower.

Dean's Fuel Panels To Bar Secrecy On Future Parleys

NPN News Bureau

CHICAGO—Secrecy that has heretofore surrounded all meetings of fuel oil men under the supervision of Dr. Joel Dean, OPA, is to be broken, and publicity will be given out regularly, countrywide, with the assistance of the fuel oil distributors' associations.

Frank E. Spencer, Chicago, chairman, distribution division of Oil Heat Institute, said that procedure was unanimously agreed upon at the fuel oil distributors' association panel meeting with Dr. Dean held in Washington on Nov. 19. The new procedure will enable the industry to keep up to date and maintain public consciousness of the need for fuel oil rationing until supply conditions change materially, Spencer said.

In a bulletin to the industry, he outlined discussions that took place at the Washington meeting. After due consideration, he said, it was decided to prepare statistical information based on 65 degree temperature instead of 60 degrees, largely because the industry and the public have been educated to the 65-degree method of computation. The 60-degree plan has been under consideration for some time.

Relief for Wartime Tenants

Occupants of large, private homes converted into apartments or rooming houses in some areas, who have been having difficulty getting sufficient coupons for comfortable fuel oil heating are to have relief, he continued. "In any event," he said, "Mr. Dean and his staff now thoroughly understand the problem and, as

Refiners of District 2 Win PAW's Praise for Sharing Crude Oil

CHICAGO—Increasing stress on refiners and the entire oil industry in District 2 due to the shortage of crude and the co-operation among refiners in meeting the wartime strain is clearly shown in a list of 21 Mid-West refiners who are giving up 54,995 b/d of their crude supply in order that other refiners in more dire circumstances may be helped. The list for the month of November has just been released by PAW.

PAW was liberal in extending praise to companies daily sacrificing a part of their crude supply for the benefit of others.

All war plants in District 2 come first in obtaining crude supply under PAW instructions issued some time ago. These instructions provide for such war plants getting 100% of minimum crude requirements for manufacture of maximum war products. Other refiners are presently on the basis 80% of their base period normal runs (July, 1941 to December, 1942), which figure is determined by the overall supply of crude available within the district.

Companies giving up part of their crude and those receiving it to aid in their operations during November were:

Supplying Company	Amount b/d	Received By
Aetna Oil Co.	800	Louisville Ref. Co.
Allied Oil Co.	1,380	Petroleum Specialties, Inc.
Ashland Oil & Ref. Co.	1,000	National Refining Co.
Bay (Saginaw)	400	Marvel Refining Co.
Champlin Refining Co.	1,000	Kanotex Refining Co.
Cities Service Oil Co.	2,000	Eldorado Refining Co.
Deep Rock Oil Corp.	200	Mid-Co-op Wholesale Refining Co.
Gulf Refining Corp.	7,265	Arrow Petroleum Co.—1,365 b/d Louisville Refining Co.—500 b/d National Refining Co.—2,400 b/d Sun Oil Co.—3,000 b/d
Farm Bureau Oil Co.	500	Louisville Refining Co.
Ohio Oil Co.	2,300	National Refining Co.
Pure Oil Co.	2,000	Rock Island (Indianapolis)
Roosevelt Oil Co.	1,100	Marvel Refining Co.—100 b/d Midwest Refining Co.—1,000 b/d
Shell Oil Co.	1,000	Globe Oil & Refining Co.
Sinclair Refining Co.	11,660	Sun Oil Co.—9,000 b/d Worth Refining Co.—2,660 b/d
Standard of Ohio (Michigan)	1,900	Crystal Refining Co.—700 b/d Old Dutch—700 b/d Lakeside Refining Co.—500 b/d
Standard of Ohio (other)	4,050	Louisville Refining Co.—500 b/d Advance Refining Co.—1,750 b/d Rock Island (Indianapolis)—1,000 b/d Stoll Refining Co.—800 b/d
Standard of Indiana	2,000	Bay (McPherson)—500 b/d Derby Oil Co.—1,500 b/d
Skelly Oil Co.	1,800	Eldorado Refining Co.
Texas Company	2,190	Johnson Oil Supply—1,190 b/d National Refining Co.—1,000 b/d
Socony-Vacuum (E. St. Louis)	350	Globe Oil Refining Co.
Standard of N. J. (Big In. PL)	10,000	Globe Oil Refining Co.—7,500 b/d Louisville Refining Co.—500 b/d
Marimac Oil & Producing Co.	100	Cascade Refining Co.

I understand it, will send out instructions to various ration boards," which will take care of the change of circumstances. "Change of circumstances" provision in Ration Order 11, does not seem to have been satisfactory or sufficiently utilized, although Dr. Dean and his staff thought that provision would take care of the apartment and rooming house conversion difficulties, Spencer said.

Scarcity of range oil or kerosine, which is often used for the same purpose, probably will preclude issuance of an order limiting deliveries to a minimum of 50 gal. Some customers, it was explained, use only very small quantities, and 50 gal. would give them an excess and at the same time increase the scarcity of the products on the market. However, an order may be issued applying the 50 gal. minimum to users of 500 gal. annually, Spencer said.

Suggested minimum delivery of 100 gal. of domestic fuel oil to users of not less than 800 to 1000 gal. annually, met with "substantial approval" of Dr. Dean and his staff at the meeting. Industrial fuel oil minimum delivery, however, came in for a lot of discussion because of varying regulations of storage. In New York City, it was pointed out, regulations prevent the installation of storage tanks having a capacity of less than 1500 gal. In the Mid-West, at least in Chicago, there are said to be very few users of industrial fuel who do not have storage for 1000 gal. In the Minneapolis district, no deliveries are made to such customers of less than 400 gal.

"Apparently," Spencer said, "in most areas deliveries of industrial fuel oils are regulated by the various sizes of tank wagon compartments."

Minimums on Local Basis

In view of these things, minimum deliveries will have to be fixed on a local basis to fit conditions, but the matter is being investigated further.

Completely revised fuel oil rationing regulations to take the place of Ration Order 11 and its 87 amendments are still in process and may not be out for several weeks, OPA told the fuel oil men, but it is intended to include in the new order all current regulations in as simplified form as possible.

The panel members were also advised that a new, simplified Form 1104 is about ready for issuance, and that new Forms 1102 and 1103 are in process of being made up.

Delay in issuing the new Form 1104 has caused difficulty for some fuel oil distributors, panel members pointed out to Dr. Dean and his staff, according to Spencer, but since they are unable to explain satisfactorily why customers ran out of coupons so early in the heating season, the only solution offered was that the customers submit their cases "promptly, fully and frankly" to local ration boards for whatever consideration is due.

Eastern Importers Push for PAO 5 Court Test; Challenge Hurled at Broad Powers of PAW

NPN News Bureau

NEW YORK — PAW is faced with what appears to be its toughest fight as the Eastern Petroleum Importers Conference moved ahead over the week-end with plans to battle PAO 5 in the courts. The contest now shaping up on the importation licensing order promises to be the industry's most vigorous and extensive challenge yet made of PAW's broad claims of authority. A legal decision on PAO 5 likely would largely define PAW's powers in the issuance of other orders as well as on the vital question of product importation into District 1.

Following its conference here Nov. 22 with District and national PAW officials, E.P.I.C. says the next move is up to PAW. Virtually no agreement on the interpretation of PAO 5 resulted from the conference, and E.P.I.C. is prepared to make no further overtures to PAW but go directly to the courts in an effort to scrap PAO 5. Several courses of legal action may be taken, including a plea for injunction to prevent PAW enforcement of PAO 5, or mandamus action to compel PAW to issue importation licenses where requested.

E.P.I.C.'s argument was laid down at the Nov. 22 meeting which proved to be a battle of attorneys. L. A. Odom, of Odom, Bostick & Taylor, Spartanburg, S. C., and J. Howard Marshall, assistant deputy administrator and PAW chief counsel, presented the respective cases for both sides. It was Odom's first appearance as attorney for E.P.I.C. He defined the issue at the outset with a statement that E.P.I.C. desired to discuss only the written instrument PAO 5 "without admitting or denying the legality, necessity or constitutionality" of the order.

Odom Outlines Complaint

Mr. Odom said E.P.I.C. did admit that under the order as now drawn, PAW has the right to grant or decline permissions to import on either of the following grounds:

1. To achieve maximum efficiency of transportation of product.
2. To relieve needs at points in designated areas where such needs exist.

"On the other hand," said Odom, "we deny that PAO 5 either expressly or implicitly gives authority to PAW to refuse an application to import on any of the following grounds:

"1. Because the applicant did not import in 1941.

"2. Because the receipt of such product would give the applicant more than his industry position under Directive 59.

"3. Because the product is being shipped to an original supplier from its source outside District 1, whereas shipments by the original supplier should be included in their shipping schedule and subject to the limits of their allocation and made available by assignment.

Denials Have Been Few

"4. Outside of a few isolated cases no denials have been made because of the transportation question or because the product to be imported was not needed in the area of destination, these being the only 2 reasons which could be used for the denial of a permit according to the wording of the order.

"5. Because the applicant will not join the Defense Supplies Corp. extra compensation pool.

"6. Because the order does not permit the Director to announce to an applicant that future applications will be denied regardless of circumstances."

Mr. Odom further presented three complaints against PAW in the way it has administered PAO 5. These were:

PAW should not require an endurance contest from each applicant.

PAW should not go on fishing expeditions in an effort to determine the nature and extent of every incidental importation if it fully intends to deny the application later.

PAW should not foster and encourage the "magna carta of monopoly" known as PAO 5.

Demand Strict Compliance

E.P.I.C. further contended that PAW has no right indirectly to enforce Di-

(*Continued on p. 38*)

DEATHS

Maj. Fawcett

Maj. James A. Fawcett, 82, owner of the Crystal Oil Works in Rouseville, Pa., died Nov. 25 at the Oil City Hospital. Maj. Fawcett assumed the management of the Crystal Oil Works in 1890. Later, he and his father bought the plant, Maj. Fawcett becoming sole owner in 1904, later becoming associated with Col. E. V. D. Selden, he was operating the oil works at the time of his death.

He was a director of the Pure Oil Co. before it passed into ownership of the Ohio Cities Gas Co., secretary of the Oil City and Titusville Refiners' Assn., and a member of the American Petroleum Institute. He served as mayor of Oil City from 1896 until 1899, and served as a major in World War I.

Survivors are a son, John W. Fawcett II, and a daughter, Mrs. Wellington E. Weidler, both of Oil City, five grandchildren and two great-grandchildren. Burial was in Lakeview Cemetery, Cleveland, Ohio, Nov. 27.

Snags in Oil Restrictions Test Negotiating Tact of All Factions

Imperfections in the Regulations Should be Worked Out By All Concerned, Including Independents, as Well as All the Facts

By Warren C. Platt

THE independent bulk distributors of the East Coast who are asking to be allowed to import petroleum products without regard to some of the restrictions imposed by PAW 59 and PAO 5, are not propounding as simple a problem as it may seem at first glance.

The real question goes back to the whole matter of country-wide supply of all petroleum products. Are we facing a far more serious shortage than government authorities have so far admitted, a shortage that, because of the refusal of the White House to make it possible to find more oil in this country, is going to get far worse than most people imagine unless Germany drops out of the war by Christmas or some such early date?

Only a complete divulgence of all facts regarding oil supply and the military requirements of oil for 1944, with an evaluation of those facts without regard to their effect on the 1944 election, will make it possible for the eastern independents or any one else in the country, really to know where they are headed.

Before members of the industry get further involved in their present discussion it would seem best for all, including PAW, to demand of the government all the facts on oil, including the military facts, and go to Congress to get those facts, if necessary. Any necessity for keeping them as "military secrets" has long since passed, in the opinion of many, because, if Hitler has not figured out sufficiently for his purposes how much bombing he is going to get, what our field and sea activities might be, all requiring petroleum, from information already released by the War and Navy departments, then it could only be because he has run out of lead pencils.

If we understand the contention of the East Coast independent distributors, it is that they be allowed to go to refiners in Dists. 2 and 3, or anywhere else for that matter, and buy what they can and bring it into Dist. 1, all without regard to whether that quantity is greater or less than the proportion of their gallonage has been in the past to the total gallonage of their own marketing territories.

Just how these independent importers into Dist. 1, should be treated as to paying any sums into the freight compensation "kitty", or be paid for extra freight cost by Defense Supplies corp. or whether PAW in Dist. 1 has authority to require them to get importing permits—all these we believe are aside from the basic question which is, whether they shall be allowed to go where they wish and buy what they can, providing they supply the proper ration coupons where needed.

The contention of the East Coast independent importers, seems to be based on the assumption that there are petroleum supplies rather freely available at Independent refineries and that such supplies will continue to be so available.

But that does not seem to be the case, taking the independent refiners of Dist. 2 and 3 as a whole. (For the sake of this discussion we can leave California out.) There have been times in the past when these western independent refiners had products they could not sell, because there was no transportation, at least officially available. Perhaps there is a refiner with free supplies on hand today but if so we have not heard of him, at least not supplies in any quantity. A large number of buyers tell us he does not exist.

Today there are two classes of independent refiners, those few with enough of their own crude oil production, or permanent connections, to fill all their needs and those many other independent refiners who have been stopped by price ceilings from going out and bidding for more crude oil, and who are stopped by WPB refusal to give them drilling equipment to drill more wells and thus getting more crude. This second large class of refiners today is existing only because of PAW giving them crude oil from a special pool of crude contributed by the major oil companies, at the request of PAW. In fact in some cases it might be said the crude is contributed only on the demand of PAW.

This second class of Independent refiners, and there are some big ones in it, too, do not like their predicament but the government, through OPA and WPB, and the White House, will not let these refiners make any move to improve their lot, will not permit them to go out and get more oil, unless they have the cash to carry on expensive wildcatting mostly at a loss.

Then seriously effecting the operations of all refiners, majors and Independents are two other factors,—

1—Steady decline in crude output per lease in this country due to lack of drilling, and

2—Necessity for the government, through PAW and the Army and Navy, in sorting out crudes by quality and sending certain kinds of crudes to certain refineries in order that the maximum of the vital war products may be made.

Still further complicating our supplies are the importations, which PAW hopes can be increased, of mostly low gravity Venezuela crude and the bringing out of West Texas of considerable "sour" crude. But these two types of crudes will have to be run in refineries without disturbing the efficient operation of refineries on the sweet high gravity crudes from which our vital war oil products are made. Some independent refiners will be given much of this West Texas "sour" crude but with it will have to go a lot of new alloy steel equipment and that is another problem not yet solved, we believe.

Over all this complicated picture hangs the increasing military demand which today is taking more than 33% of our gasoline output. This is increasing steadily so that the forepart of next year it will easily be 40% or more and later 50% and a possible 60% by next Fall.

When demand exceeds supply there is just one of two things that can be done,

1—Let the demand bid up the price until a higher price has sucked in more supply, or

2—Let government forbid such price bidding and instead parcel out the current supply fairly to all claimants.

The government has elected in this war, as it did in the last war, to limit price and, because of the lack of steel, to limit the search for more oil supplies, and to allot as fairly as it can, what is left over after the war needs have been taken care of.

PAW Allots Supplies

While the government has concerned itself in allotting oil supplies mostly only with the final consumer, PAW and allied agencies have allotted supplies through having to allocate limited transportation facilities to the East Coast. However, as war demand has increased, PAW has actually been allotting supplies within the oil industry.

In Dist. 2, PAW has insisted that there be some fairly reasonable division of the majors' supply of crude oil so that the independent refiners can continue to operate. PAW in Dist. 2 also has insisted that both the majors and the independent refiners divide what is left of their output after supplying the east coast requirements and our direct war needs, fairly according to past gallonage between their own bulk plants and their independent jobbers, and between their own service stations and those of independent dealers regularly served by them.

It is no secret that a number of majors and several independent refiners, bucked on such a division of their supplies and that PAW Dist. 2 Director Vandeveer pounded the table pretty hard as voices raised, and told all concerned they either would treat every one fairly and divvy up what they have with the companies that haven't got it, or "there will be a Direc-

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tive 59 out here which I don't want," he is quoted as saying.

Reports keep recurring that a "Directive 59" is in the making for Dist. 2 and is likely to be put into effect most any day. At the annual meeting of the Ohio Petroleum Marketers at Columbus the other week, Dist. 2 Director Vandeveer prophetically declared,

> "We feel it is our duty to see that parity in the distribution of . . . . available supplies is maintained. . . . There can be no justification wherein any group forces an unfair advantage and improves its market position at the expense of a competitor during this period of emergency."

If PAW does not stick to this position then those who have the crude oil will be free to run it all in their refineries, which means the immediate closing down of several score of independent refineries if the owners of the crude do not take care of these independents out of generosity. It means that those who have the products will be free to distribute them first through their own bulk plants and retail outlets, unless they generously split up with their competitors. And finally it means that there will not be any more crude or refined products sent to the East Coast than is necessary to take care of direct war needs.

Whatever "free" refinery products now seem to be available to east coast independents therefore are due to

a—Rationing of the crude oil of major oil companies to Independent refiners, and

b—Preventing refiners from "taking care of their own" and causing them to send part of their output to the East.

There is a third source of "free" oil and that is the imperfect working and the juggling, perhaps even intentionally in some cases, of products and crude between refineries and majors on "exchange" arrangements. We have heard some odd stories about some western refiners who never could get to the east coast, selling "exchange" gasoline there a thousand miles away. Certainly this is not treating fairly either east coast independents who were not fortunate enough to get this "exchange" gasoline or the majors.

Restrictions Work Unfairly

Where the East Coast Independents, and others in the country probably also, have just complaint is in the unfair working of the government's restrictive effort so far. Some of that unfair working was due to the size of the job of getting restrictions evolved, some of it was due to faulty thinking on the part of the PAW committees and this in turn undoubtedly was due to the failure of PAW to give at the outset fair representation on the important committees to the independents.

PAW committees said that no products could come into the East Coast area except as approved by them and in transportation they provided. Then these committees said, in effect that they had obtained all the possible transportation facilities and had them in use. Whereupon a number of independent distributors showed these committees that they were wrong by digging up transportation facilities the committees seemingly did not know about. Without in any way interfering with the committees' official efforts, these independents brought in large quantities of additional supplies and thereby greatly aided the consumer in the east.

In other words, had the committees been properly representative of the industry on the east coast, the committees and the consumers would have had the benefit of the ingenuity and the extra knowledge of these independents and still more products undoubtedly would have been brought in.

It is a sad joke on the official committees that the independent who has only a 162 b/d "position" in the products line across northern Florida has been putting 2,000 b/d through that line, and so far as we know still is, because the official committees do not seem able yet to find the additional transportation facilities to bring 2,000 b/d to the western end of that pipe line. Why? We don't know except that is the way of committees.

Since many of these independents are able to find seemingly "free" products in the Middle West and are successful in finding and using seemingly surplus transportation facilities to bring these products into the East, IN ADDITION to the products "officially" brought in, it is but natural for these eastern independents to rebel against restrictions that hamper their own efforts better to serve their customers.

Should Work in Theory

Theoretically, with all the restrictions working perfectly, there should not be any "free" products in the West, nor any additional transportation facilities to bring them into the east. And, theoretically, under all the restrictions every one should get a fair allotment of products and be protected against his competitor getting any advantage over him due to the war, which means protecting every one's past position in the market.

As it is absolutely a fact that there is a shortage of crude and of refined products, and as it is a fact that the shortage for the civilian consumer is going to get much worse—unless Germany drops out soon—it would seem that the only solution to the difficulties of the independents, both east and west—and majors too—lies in getting restrictions that are fair and then seeing that they work out fairly to all, for as long as the war lasts and until supplies get "easy" we will have restrictions aimed to keep to a minimum the business fatalities due to the war.

The solution, then, should be reached by the oil men within the structure of PAW. If that structure needs changing, to admit of more negotiators, then change it. PAW Director Dodge of Dist. 1 has made many changes in PAW structure since he took charge six months ago. He has admitted more independents into the secret circles. If still more should be

(*Continued on p.* 16)

Justice Department Report Backs Co-op Charges; Aiken Calls for Dual-Salary List in PAW

NPN Staff Special

WASHINGTON — Commenting that the Department apparently was powerless to prosecute, Senator Aiken, of Vermont, made public this weeek a Justice Department report which he said found that charges made by East Coast farm co-operatives that employes of "certain oil companies and various Government agencies" were in league to put them out of business were "substantially true."

At the same time, as an apparent outgrowth of the Justice department report, the Vermont Senator announced that the Senate Agriculture Subcommittee on Food, of which he is chairman, has called on PAW to furnish the committee with the names of all PAW employes who are receiving compensation from both PAW and private companies.

Stating that the committee's interest "has broadened considerably" since it first began its inquiry, Senator Aiken said "there has been so much talk that there are those who are drawing two salaries that we thought it should be made clear who they are and what their company connections are." He added:

"Personally, I do not think the practice advisable. In my opinion, it would be difficult for any one so situated to serve in an unbiased manner. The particular official may think he is unbiased, but unconsciously his judgment will tend to be influenced by his company connection in private life."

Request 3 Weeks Old

Senator Aiken said the request for the list of PAW's dual-compensation employes was dispatched "three weeks or more ago," but that the committee had not yet received a reply. "We will wait a reasonable length of time for it, but we won't wait too long," he added.

Made at the request of Aiken's committee, which recently heard co-op witnesses testify that District 1 oil companies were withholding gasoline for farm use from co-operative distributors in an attempt to kill off competition, the Justice Department investigation was conducted by W. B. Watson Snyder, special assistant to the Attorney General assigned to the petroleum unit of the anti-trust division.

Findings Summed Up

Summing up Snyder's findings, Assistant Attorney General Wendell Berge wrote Senator Aiken as follows:

"Representatives of the co-operatives refer to the activities of certain oil company employes as indicative of the carrying out of the alleged design to put the co-operatives out of business. Investigation revealed that such activities were engaged in by either employes of the Office of Petroleum Administration for War or employes of oil companies who are members of various industry committees operating under the directives promulgated by the Petroleum Administrator for War."

Mr. Berge then went on to point out that "a great many of these directives" of PAW, including Directive 59 which was the sore spot of the co-ops' complaint, had been certified to as necessary to the prosecution of the war by WPB Chairman Nelson, acting under Section 12 of Public Law No. 603, 77th Congress, but that the Attorney General's approval was not a prerequisite to the issuance of such a certificate voiding prosecution under the anti-trust laws. The law merely requires "prior consultation" with the Attorney General, he said, adding that on one occasion Justice had objected to the issuance of a certificate "but despite its views it was issued."

"In conducting prior consultation with the War Production Board and the other government agencies charged with furthering the war effort," Mr. Berge concluded, "we have advised and cautioned these agencies to avoid the delegation of functions which should reside exclusively in government officials to non-governmental groups. We have advised the agencies to give earnest consideration to the degree to which competition would be eliminated by the proposed programs and to consider whether the war need justified the elimination of such competition. The third point recommended the imposition of reasonably adequate safeguards to protect the interests of those outside the participating group who may be adversely affected by the operations of the program as well as the protection of those asked to participate."

As a result of Berge's report, Senator Aiken observed that "the hands of the Justice Department are apparently tied" insofar as possible prosecution under the anti-trust laws is concerned.

"The Attorney General," he said, "would seem to have no veto power over decisions of the WPB Chairman, and there apparently is no way the Justice Department can take action against monopolies if the WPB Chairman decides a monopoly is in the public interest."

NPN asked Aiken whether he was considering an attempt to amend Section 12 of Public Law No. 603, but the Senator replied that he had not given this any thought. He recalled, however, that at the time Section 12 was up for Senate consideration, former Senator George Norris of Nebraska had warned of the possibility that the provision "could be used to do more harm than good."

DSC Disburses $230,338,447

WASHINGTON — RFC Chairman Jesse Jones disclosed Nov. 24 that disbursements by Defense Supplies Corp. for petroleum compensatory adjustment claims through Oct. 31 totaled $230,338,447. As an offset, DSC received $128,511,306.64 from the East Coast transportation pool.

WAR OIL NEWS from WASHINGTON

HERBERT YOCOM *Bureau Chief*
NATIONAL PRESS BLDG
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Half-Cent Fuel Oil Surcharge Made Uniform for East

WASHINGTON — Standardizing widely differing practices prevalent up and down the Atlantic Coast, OPA Nov. 29 established a uniform surcharge of 0.5c per gal. on deliveries of less than 100 gal. of No. 2, 3 and 4 fuels in 15 Atlantic states and the District of Columbia.

The new ruling becomes effective Dec. 4 in all of District 1 except Georgia and Florida, and is embodied in Amendment 141 to RPS 88.

Deliveries of less than 100 gal. which have been increasing in number and importance due to shortages and requirements of rationing, are a new type of business to the reference tank wagon sellers in these areas, OPA explained, as these suppliers generally refused to make such deliveries during the base period.

Other sellers, especially smaller sellers, did make small quantity deliveries. Some made no extra charge; others charged varying amounts up to 1.0c per gal.

The various specific spell-outs of tank wagon prices that have been issued for local areas have all included this 0.5c per gal. surcharge.

Refinery Ceiling Increases In Eastern Area Revoked

WASHINGTON—OPA Nov. 29 revoked previous increases in price ceilings for f.o.b. refinery and terminal sales of gasoline and fuel oil in the western section of West Virginia, Pennsylvania and New York for shipment to other parts of the eastern seaboard area.

The reductions amounted to 1.2 cents per gal. on gasoline, 1.5 cents on kerosine and distillate fuel, and 30 cents per bbl. on residual fuel oil. Earlier increases of these same amounts had been granted to compensate importers of petroleum products in District 1 for extra transportation expenses.

Existing selling prices will not be reduced by such amounts since most sellers have not been charging the allowed increases, OPA said. Action was taken in Amendment 142 to RPS 88.

Disney Bill Backers Optimistic, Push For Early Decision

WASHINGTON—Supporters of the Disney crude price bill, although confident that it will be passed, are overlooking no bets in their efforts to assure a majority vote when the crude price measure comes up in the House Dec. 13.

Leading advocates of the legislation held one strategy-mapping session this week, and will meet at least once more before the measure is brought to a vote.

The Disney bill would transfer oil price powers to PAW and direct the oil agency to fix a ceiling price on crude and its products and derivatives the index of which would be equal to the price index of "all commodities" as reported from time to time by the U. S. Department of Labor.

Graph Reveals Low Price

The "all commodities" index (*see graph*) stood at 103.0 in October, this year, compared with a crude oil index (based on average Mid-Continent crude price) of 58.9. The crude oil index at 58.9 equals $1.11 per bbl., and at 103.0 would equal $1.94 per bbl., up 83c. Between June, 1941, and October, 1943, the "all commodities" index increased 18.2%, the "raw materials" index 33.9%, and the crude oil index 0%.

Although several present at this week's strategy meeting were in favor of waiting until after Christmas to start the bill through the House legislative mill, it was definitely decided to bring it up on Dec. 13, the first day under House rules on which the bill can be considered.

Here is the route the bill will probably follow:

On Dec. 13, motion will be made on the House floor that the bill be discharged from committee. It automatically will become the business for first discussion on the following day. At that time, a motion will be made that the bill be presented and debate and speeches will follow. At any time during the debate, a motion can be made that the bill be voted on. After it has been determined that a quorum is present, the bill can be voted on and will require a majority vote of those present for passage. From there, if it passes, the bill will go to the Senate.

Expect Real Fight In Senate

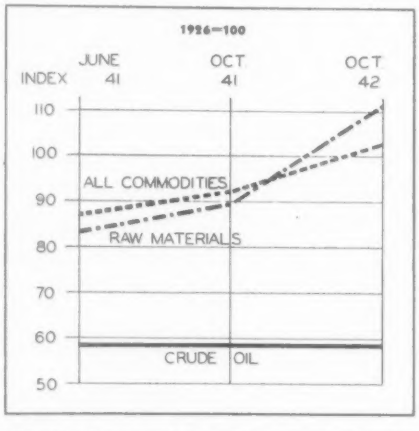
Proponents do not expect the Administration to make any serious effort to block passage in the House, believing that the New Deal will fire its big guns, if any, when the bill reaches the Senate. That the Senate, however, will itself approve the legislation was regarded as a virtual certainty by Rep. Disney and other of the measure's proponents.

As to the fate of the bill when and if it reaches the President, there are some in the House who express the belief that he will not dare veto the measure, although these are few in number. On the other hand, the theory has been put forth that the Administration may find it politic now to express satisfaction with action which would raise crude prices only 35 cents per barrel, as advocated by PAW Ickes, if the Disney bill, which some estimate would advance prices about 70 cents per bbl., was withdrawn.

Rep. Wesley Disney
Speedy Action His Goal

However, no such move has evidenced itself as yet, and congressional crude price proponents are disposed to bring the bill to a vote, pass it in both houses, and send it to the President.

In Washington this week was New Mexico's Gov. John J. Dempsey "to work in behalf of our recommendation that the price of crude oil be fixed at parity." On Nov. 19, he sent a letter to governors of all non-oil producing states asking that they "bring this matter to the attention of your state's congressional delegation with the recommendation that prompt action be initiated to avert a crucial gasoline and fuel oil shortage."



Graph shows relation between index for crude oil and indexes for raw materials and all commodities. Between June, 1941, and October, 1943, the "all commodities" index increased 18.2%; the "raw materials" index 33.9%; the crude oil index 0%

OPA Answers Attack By House Group; Defends Policies

NPN News Bureau

WASHINGTON—The Office of Price Administration this week answered criticism recently directed against it by the Select House Committee to Investigate Executive Agencies (Smith Committee) and others (*see NPN Nov. 17, p. 3*).

Asserting that OPA welcomes constructive criticism, makes no claim to perfection, and is willing to correct any practice which is shown to be improper, OPA spokesmen asked opportunity to be heard before being condemned.

Since the prime target of OPA's critics has been its enforcement activities, especially its system of administrative hearings and suspension orders, OPA defenders gave this issue their chief attention.

Says OPA Uses Care

OPA has taken "extreme care" to set up a fair and orderly procedure for suspension order cases, following closely the recommendations of the Attorney General's committee on administrative procedure in 1941, according to Thomas I. Emerson, deputy administrator in charge of enforcement. This procedure provides for a full hearing, an appeal from the original decision to the hearing administrator, and judicial review by the courts of the administrative determination, he said.

Answering Smith Committee's charge that "OPA consistently avoids recourse to courts wherever possible" and obstructs access to the courts for judicial review of the hearing administrator's decisions, Mr. Emerson said that through Oct. 1, OPA had availed itself of remedies requiring court action in 3194 suits for injunction, 417 treble damage suits, and 4013 criminal prosecutions, as well as taking the first step in license revocation proceedings—issuance of a warning notice—in 14,346 cases. These figures compare with 5563 suspension proceedings.

Injunction Weapon Available

That there is no impediment to appeal to the courts in rationing cases, where suspension orders are involved, was the flat statement of Shad Polier, director of enforcement for fuel and consumer goods, when questioned specifically on this point by NPN. The weapon of injunction is available to the citizen against a suspension order as it is against any other administrative act, as soon as he has exercised his right of appeal to OPA's hearing administrator. The requirement that a man must exhaust his administrative remedies before he appeals to the courts for judicial protection from a threatened injury, is no invention of OPA but was originated by the courts themselves, Mr. Polier asserted.

Mr. Polier denied charges that routine inspections of business premises for evi-

dence of ration violations are "unlawful searches", asserting that one of the conditions on which allocations of rationed commodities are made is that dealers maintain records open for inspection at all reasonable times.

PAW Reveals Program To Supply Military 'Lube' Requirements

NPN News Bureau

WASHINGTON—Under a program started shortly after Pearl Harbor, the oil industry now has in operation five major lubricating oil plants to meet military and essential civilian needs; and three more are scheduled for completion early in 1944, PAW Ickes announced this week.

At the outset of the war, 74 refiners were producing about 105,000 b/d of base stocks for lubricating oils, Mr. Ickes said, and today's production is geared to keep pace with the expanding military needs and to stockpile against future requirements as far as they can be foreseen.

Deputy PAW Davies pointed out that the program has been financed by the industry from its private funds, at no cost to the public, and said that this is additional evidence of the patriotic cooperation which the oil industry has given in its outstanding job of conversion from peacetime to wartime production.

20 Plants Improved

Four of the projects called for construction from the ground up while the other four are classed as "major alterations to existing facilities." In addition to the new construction, minor improvements were made in about 20 operating refineries to remove bottlenecks and speed output.

About 10 per cent of all present production is for passenger cars; 7 per cent is of grades used generally in commercial trucks and buses; and the remainder, or about 83 per cent, is for aviation engines, other military and lend-lease purposes and other uses such as refining special grades of industrial, commercial and medicinal oil, PAW said.

The eight projects were sponsored as follows: Sinclair at Houston; California Standard at Richmond, Calif.; Mid-Continent Petroleum Corp. at Tulsa; Texaco at Port Arthur, Tex.; Quaker State Oil Refining Corp. at Emlenton, Pa.; Sun at Marcus Hook, Pa.; Champlin Refining at Enid, Okla.; and Gulf at Port Arthur.

Secret Service Urges Caution In Handling Checks

NPN News Bureau

WASHINGTON — The U. S. Secret Service of the Treasury Dept. has issued a warning to all persons who receive or cash checks to be on the alert for mail thieves and forgers, numbers of which have increased due to the great number of checks currently being issued by the government.

Canol Project Is 'Indefensible', Truman Says; Sessions Halt With Somervell Unheard

NPN News Bureau

WASHINGTON — The Truman Committee wound up public hearings on the Canol project at least temporarily last week, after hearing further testimony from 2 War Department generals who had participated in the 3-hour conference in mid-1942 at which Canol was born.

An indication of what the committee's report will have to say when it is issued was provided in a remark by Sen. Truman to reporters that the project was a "bad" one, should never have been undertaken and was "indefensible from any standpoint".

The Missouri senator said that he had been left unimpressed by the testimony of Under-Secretary of War Patterson who said the War Department was proud of Canol; that the project was a result of the Army's vigorous efforts to produce a local supply of petroleum products along the land and air route to Alaska, and was a "bold undertaking".

"The results so far have surpassed our hopes; we are confident that even greater success lies ahead," said Mr. Patterson.

To all of this, Sen. Truman observed that the project cannot be utilized before next spring and that transportation costs of moving oil to the refinery at Whitehorse via the 550-mile 4-in. pipeline from the oil fields at Fort Norman do not justify the use of manpower involved.

These objections, he added, together with the apparent failure of the War Department to make any analysis in advance, made the project indefensible on all counts.

The committee to date has not decided whether to issue an interim report on its findings so far, or to wait until some time after hearing from Lieut. Gen. Brehon Somervell, chief of Army Service Forces, whom the committee has invited to testify at an open session.

Last witnesses heard on the project were Brig. Gen. Walter B. Pyron, the Army's principal consultant on petroleum matters, and Maj. Gen. A. H. H. Carter, an accounting expert. Both had been consulted by Col. James H. Graham, whose 1-page recommendation on the project was evidently the basis of Gen. Somervell's directive which got the project under way.

Gave "Tentative Opinion"

Gen. Pyron said his discussion on Canol concerned only Norman Wells production and that, at the conference, he had offered the "tentative opinion" that there was a good prospect for 3000 b/d production from the field, although he would not go so far as to guarantee it.

Sen. Truman remarked that Gen. Pyron's opinion had proved correct (Mr. Patterson in his testimony said that a 20,000 b/d production was now "assured") and added: "It turned out to be a very successful wildcat venture apparently, for which we're all very happy. But I still don't think it was worth $130,000,000."

All the hubbub over Canol brought on by the testimony of PAW Ickes, officials of WPB and the Budget Bureau, and the stellar parade from the War Department gradually died out in the latter part of the week only to be revived on Nov. 29 by the remarks of Rep. Poulson, Cal., on the House floor.

Mr. Poulson said there were other "implications", aside from the Canol "fiasco". "One," he added, "is the attempt by friends of Lieut. Gen. Brehon Somervell to place the blame on some subordinates, but I think the record will definitely prove that no oil man of any credibility has recommended this field to Gen. Somervell. So, therefore, the blame should definitely rest upon the man in charge of this department, Gen. Somervell."

Compensatory Dispute Delays Sour Crude For District 2

NPN News Bureau

WASHINGTON—Tank car shipments of sour crude to District 2, scheduled to start Dec. 1, will probably be postponed pending the ironing out of complications created by the White House edict barring payment of subsidies to elements of industry whose incomes place them in the excess profits tax brackets.

PAW and RFC Chairman Jesse Jones, through Defense Supplies Corp., are working co-operatively in a joint effort to find their way around this obstacle. Repeated conferences have been held, none of which has as yet borne fruit. It is possible that District 2 leaders may have to be called to Washington before any final decision can be made.

Meanwhile, the delay has aroused the ire of District 2 refiners. Paul G. Blazer, Ashland Oil and Refining Co., on Nov. 24 labeled the act of DSC "discriminatory." He said it would seriously interfere with the District 2 refining program. Mr. Blazer is chairman of the District 2 refining committee.

Correction

NPN erroneously credited the PIWC economics committee, headed by Dr. R. E. Wilson, with information from which the graph on p. 5 of the Nov. 24th issue was prepared. Also erroneously credited to the economics comtee was the statement accompanying the graph. Both the statement and information from which the graph was drawn were issued by the Cost and Price Adjustment Committee of the PIWC, chairmaned by Dr. John D. Gill, Atlantic Refining Co.

PIPELINES—*Views of the Industry's Problems a*

Washington— *Truman To Widen Inquiry Into Canol* —By Herbert Yocom

WASHINGTON — Undersecretary of War Patterson's defense of the Canol project before the Truman Committee becomes all the more disturbing when it is considered in the light of the following excerpt from his prepared statement:

Mr. Yocom

"The Canol project, so far as I know, is the first major venture of the United States Government in oil production on foreign soil. After our experience with gasoline rationing and the serious depletion of our own crude oil reserves, I believe that the American people may favor similar ventures in the near future."

The statement is disturbing because, on the basis of the Army's performance in connection with Canol, the thought of a lot of other "similar ventures" scattered willy-nilly throughout the world is enough to give any taxpayer a nightmare. All of which will explain why, now that it has heard what Mr. Patterson has to say in a general way in defense of Canol, the Truman committee proposes to go even deeper into the subject for the purpose of determining how the U. S. has gone about spending the $130,000,000 it is pouring into the project.

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One Example of 'Waste'

For one thing, the committee will inquire into such matters as the reasoning which prompted the shipment of redwood lumber all the way from California for use in the construction of the contractor's headquarters at Edmonton—an edifice that cost $269,000 and which will either have to be torn down or stuccoed after the war because an Edmonton ordinance forbids buildings with wooden exteriors. According to information already in possession of the committee, apparently no effort was made by the Army to obtain the necessary lumber in Canada, although there was plenty there to be had.

Truman's group also will delve deeply into reports that this is only one example of the "waste and extravagance" that has been characteristic of the Canol deal. In the words used by Senator Truman in announcing launching of the more detailed Committee inquiry:

"Now the question is: How carefully has the Army expended the money on construction? Reports reaching the committee indicate that truck drivers have been paid lavish sums, that manpower, materials and shipping space have been wasted."

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Press Defender About Faces

Not only did Undersecretary Patterson's defense of Canol not sit well with the Truman committee, but it also provoked the reliable Washington Post into doing an unusual about-face after once having proclaimed editorially that the project, "from a purely military point of view, appears to have been thoroughly justified."

The Post had endorsed the project on the grounds that it had been approved by the Joint Chiefs of Staff, who ought to know what they were doing. But what the Post did not know at the time was that the Joint Chiefs of Staff had not acted until October 26, 1943—more than a year after the project was started. Learning of this fact, the Post backtracked immediately and in an editorial headed "Boondoggle in Oil" apologized, in effect, for having assisted Judge Patterson in what it described as his "unequivocal whitewash" of the War Department.

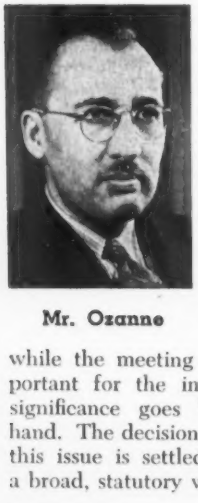
Concluded the Post (and we quote this because it seems to sum up pretty well Washington's general reaction to the Truman Committee disclosures):

"The curious and disturbing aspect of this affair is not so much that the War Department became wedded to the Canol project in haste as that it stubbornly refused to repent at leisure. Gen. Somervell and the General Staff and even the Joint Chiefs of Staff are fallible. And the Truman Committee is entirely within its proper province in calling into question their disposition of public funds.

"This is not a matter to be ignored simply because it is said to be dictated by military strategy. The War Department is unduly prone to justify any and every decision by this comfortable formula. Judge Patterson could better have promoted public confidence in his agency by a little more candor, a little less self-righteousness."

Atlantic Coast— *PAO 5 Tests Broad Subject of U. S. Control In Industry* —By Henry Ozanne

NEW YORK—Elsewhere in this issue I have reported the legal battle now shaping up on PAO 5. The controversy centering around this order regulating the importation of products into Dist. 1 is sharpening into one of the most clear-cut issues on government powers and "bureaucracy" which has yet confronted the industry. A powerful group of industry representatives has taken the position that it is time to determine where the rights of PAW begin and end. And while the meeting of that battle is important for the importers involved, its significance goes beyond the case in hand. The decision on the basis of which this issue is settled may well define in a broad, statutory way in just what manner the government can put its hand into the industry.



Mr. Ozanne

The issue is whether PAW's powers are specified and delimited for particular purposes for which the agency was created, or whether the vast War Emergency Powers Act gives PAW the privilege of an actual czar in the industry.

It has been conceded by PAW that PAO 5 is needed to keep Directive 59 "from falling apart". Here is the first point of contention: Does not the implementation of a directive with an order constitute an unwarranted blurring of government powers? A directive is a permissive instrument; an order is an enforceable one. Directive 59 is a voluntary agreement by the industry; PAO 5 is a government-imposed ruling. If any agency of government can interlink the compulsory regulations of an order with the voluntary agreement of a directive, then the coercive powers of the state have been extended in a manner entirely new to American business.

The issue is not whether control of importation into the district is needed—it is the form that such control takes, and the way the control machinery is administered. For instance, under PAO 5 just what are the powers of the district director-in-charge? The industry men argue that the director's authority is set forth in the preamble to the order itself and is limited thereby. Under that interpretation the grounds on which the director can approve or disapprove importation permits become clear—they are specified in the order. But PAW argues that the director is not so bound, and PAW has been acting on a wider arrogation of powers to itself. Applications for permit have been disallowed with the mere notation "disapproved"—no reason given.

If the conditions exist which PAO 5 spells out as necessary and sufficient for the granting of an importation license, what right has the district director to inquire into other conditions, such as the historical position of the applicant?

All this simmers down to one over-all question—bureaucratic powers of gov-

ernment. In this instance PAW is every bit as "kangaroo court-ish" as is OPA, industry men feel. PAW cites the grounds on which importation permits will be granted; PAW decides whether those conditions have been met; PAW interprets the regulation in case of dispute; PAW hears the appeal from the district decision—PAW throughout acts as judge, jury and prosecutor.

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Grievances Summed Up

And from the policy it has set for itself in those matters covered by PAO 5, certain consequences flow which are of vast significance to the industry. These have been summed up under six headings in a letter sent to District 1 Director-in-Charge Dodge by Eastern Petroleum Importers Conference, the group which is carrying the brunt of the fight on PAO 5. PAW's interpretation of PAO 5 means, it is charged:

1. Perpetuation of the monopolistic cartel of the integrated companies and the placing of an embargo on the operations of the small oil man.

2. Denial of the equality of profit and volume of sales as between the integrated companies and the small oil men.

3. Compelling the small oil man to buy from the original suppliers (who for the most part are the integrated companies) at a price penalty.

4. Perpetuation and enhancement of war profits in the integrated companies above their pre-war level by taking profits away from the small oil man.

5. Destruction of the initiative of the small oil man by prohibiting him from importing product which importation would not in any way disturb transportation schedules.

6. Implementation of Directive 59 which attempts to limit the small oil man who operates exclusively within District 1 to approximately 70% of normal, while the integrated companies which operate on a wide scale and in other districts which do not have a limiting Directive 59, have unlimited opportunity in other districts to exceed their all-district normal volume and profits. And further, the integrated companies by means of adjustments of sales volumes and profits from operations in several districts have a definite advantage over the small oil man. These massive, widespread activities within and without District 1 create inequality of sacrifice among members of the oil industry in the current wartime context of business operations.

Mid-West— *Compensatory Ban May Upset Dist. 2 Crude Allocations* —By Earl Lamm

CHICAGO—If the final decision of Defense Supplies Corp. is to allow compensatory freight rate on West Texas crude only to District 2 refiners who are not in the excess profits bracket, the entire crude oil allocations structure which has been in operation in District 2 since last May 8, is likely to break down.

Mr. Lamm

Possible adoption of that procedure was first indicated in OILGRAM for Nov. 23. If it is made effective, no refiner in District 2 who comes in the excess profits bracket is expected to run the sour, corrosive crude. That will automatically eliminate at least 30% or 40% of the 35,000 to 40,000 b/d importation proposed. Those refiners eliminated would of course demand a larger share of sweet crude since the total crude available in District 2 would be boosted by the amount of importations. That is, provided the remaining refiners imported. This shifting of supply, would leave the importing refiners little sweet crude for blending with the sour, which would mean their present plants would be eaten away by corrosion within 6 to 18 months, depending upon what alloy steel they could get for re-equipping the affected parts or making such additions to their plants as would be necessary.

Forcing the plants in the weakest financial condition to run sour crude or do without, which would be the trend, would be like striking a man who is already down, under the pretense of trying to help him up.

District 2 industry and PAW discussions on the crude supply situation in the Mid-West for months have fairly bristled with the expression "fair and equitable" distribution. If the White House edict against including all District 2 refiners in the importation plan is maintained, the "fair and equitable" idea will be destroyed, for the suggested action has been flatly described by refiners in this area as highly discriminatory.

None of the refiners can in any sense of the word be called eager to run the corrosive crude, and when the procedure for doing so was tentatively outlined by C. H. Alberding, PAW District 2 director of refining, (*see NPN Oct. 6, p. 22*) some of them decided then against attempting it even on an adjusted freight basis. Others said they could not run it because they are not equipped to do so. Among those who agreed to use it was one refiner who said O.K. to more than 12,000 b/d on a compensatory basis, but that company is not likely to take it, foot the inevitable bill for extra operating cost and maintenance, and on top of that pay 60c to 80c a barrel more for it delivered.

It is true that independent refiners have in the past paid premiums of 10c to 25c a barrel for crude during scarcity periods, but when paying even those amounts they got what they wanted—not sour crude. Then too, they had the privilege of getting more money for their products whenever the opportunity offered. They were not nailed down by OPA ceiling prices.

District 1 refiners who are now using sour crude, it was explained here, have all along been equipped to handle it. And in that area, all importers are reimbursed for extra transportation costs on both crude and products, and there is no discrimination or classification by tax brackets.

The action suggested for District 2 is considered here as just another delay or stall by a governmental agency, and in that respect nothing new. But to hazard a guess as to what is in the wind:

Jesse Jones, backing DSC, still wants to have the government buy the crude in West Texas, transport it to the Mid-West refineries and sell it at a loss, avoiding direct subsidy reimbursements. This idea is a take-off on "Big Inch" pipeline procedure, but it was pointed out here sometime ago that there is a difference. The government does not own and operate the tank cars which would transport the West Texas crude. Government does own the "Big Inch", and to follow that procedure on tank car shipments would be just another step in government control of the oil industry at a time when it should be about ready to loosen the reins. Government also already has authority to import foreign oil tax free, and Petroleum Reserves Corp. is being activated in secret. Bunched together, these things mean something unsavory in the minds of a good many oil men in this area.

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PAO 4 as City Ordinances

Since the demise of PAO 4 limiting service stations to 72 hours weekly, operators in some Mid-Western cities are sponsoring city ordinances along the old lines of the PAW order, notably, Detroit, Milwaukee and St. Louis. St. Louis has had an ordinance regulating service stations for several years. It was revised to agree with PAO 4, but the revisions have lately been dropped.

City ordinances are political measures, and sometimes it is more easy to get them passed than it is later to have them abolished or revised when conditions change.

U. S. Boosts Purchases of Texas Gasoline

631,000,000 Gals. in Year, Refiners Say

Special to NPN

HOUSTON—The government of the U. S. took 631,420,080 gals. more of Texas gasoline in the fiscal year ended Aug. 31, 1943, than it took in the year before.

Figures released Nov. 18 by Gulf Coast Refiners Assn. from its office here sum up the two-year trend, revealing the giant flood of Texas "gas" that has been poured into the federal government's million of tanks on war vehicles, planes and elsewhere. In the last fiscal year government purchases rose from 50,000,000 to 143,000,000 gals. a month, and this is not all, for much of the gasoline in the "Interstate" column of the table printed with this story goes for federal use, as well as some in the "Export" column.

The association also analyzed recently published figures on Texas gasoline taxes from the comptroller's motor fuel division. Full effect of the recent reduction in "B" and "C" coupons is not yet reflected, the association says, October figures for collections so far (on September taxes) being $4,066,985 against $4,314,723 in September and $4,675,176 for October, 1942. Perhaps $50,000 more of September tax money is still to come.

Table of sales follows:

Date	Intrastate	Interstate	Export	U. S. Gov't.	Total
1942					
Sept.	117,224,600	403,412,475	39,369,386	49,977,066	609,983,527
Oct.	114,636,596	410,355,323	46,847,712	39,773,007	611,612,638
Nov.	145,768,123	415,669,450	74,473,493	30,603,527	666,454,593
Dec.	66,280,672	387,117,923	63,285,363	32,419,143	549,103,101
1943					
Jan.	87,375,064	329,638,554	32,335,051	45,615,915	494,964,584
Feb.	95,327,649	295,644,264	47,106,170	54,618,865	492,696,888
Mar.	103,420,300	328,135,596	26,787,929	60,531,809	518,875,634
Apr.	109,683,822	375,226,239	57,086,288	89,737,604	631,733,953
May	110,686,374	394,870,322	75,111,575	119,464,101	700,132,372
June	119,626,772	439,543,407	52,726,671	117,068,776	728,965,626
July	113,474,525	373,600,469	20,558,454	122,760,121	630,393,569
Aug.	107,621,750	379,135,007	31,628,981	143,153,091	661,538,829
Total	1,291,126,247	4,532,288,969	567,317,073	905,723,025	7,296,455,314
Totals 41-42	1,485,674,881	5,537,375,975	911,999,034	274,302,945	8,209,350,835
Increase Dec.	194,548,634	1,005,006	344,681,961	631,420,080	

Table above, reduced to terms of percentages, shows:

	Percentage to Total 1941-42	1942-43
Intrastate sales	18.10	17.70
Interstate sales	67.45	62.12
Export Sales	11.11	7.77
U. S. Government Sales	3.34	12.41
	100.00	100.00

Gasoline rationing started in December, 1942. It was advertised for some months in advance and November sales shot up, December sales went away down. By March and April, it had leveled out, as shown in the following month-by-month comparison:

	Before Rationing 1941-42	After Rationing 1942-43	Difference
Nov.	132,176,238	145,768,123	13,591,885
Dec.	133,606,417	66,280,672	67,325,745
Jan.	122,555,479	87,375,064	35,180,415
Feb.	106,414,897	95,327,649	11,087,248
March	121,240,123	103,420,300	17,819,823
April	112,596,757	109,683,822	2,912,935
May	126,937,073	110,686,374	16,250,699
June	123,557,808	119,626,772	3,931,036
July	123,528,599	113,474,525	10,054,074
Aug.	115,856,346	107,621,750	8,234,596
Total	1,218,469,737	1,059,265,051	159,204,686

Military To Take 75% of His 'Gas', Coast Refiner Says

LOS ANGELES — Reese Taylor, president of the Union Oil Co. of California, in a bulletin issued to his foremen and supervisors, sounded a warning on the Pacific Coast gasoline situation.

Mr. Taylor said:

"This year, increased war activity in the Pacific has skyrocketed military demand. The armed forces are now taking 60% of the gasoline we make—78 bbls. out of 130, leaving only 52 bbls. for civilian consumption—just a little over half of what was provided for civilians in 1940.

"No one, not even the General Staff can give us accurate figures on Army and Navy needs for next year. Right now, military authorities estimate they will take 75% of our gasoline. That would amount to 98 bbls. out of every 130 we manufacture. It would leave just 32 bbls. for civilians—around 1/3 of 1940 consumption.

"California figures on net taxable gallonage sold in July of 1943 show that total civilian consumption of gasoline was only 4½% below July of 1940.

"That's a far cry from the 63% reduction we might have to face in 1944.

"The only reason we've been able to carry on at our present rate of consumption this year is because a great deal of gasoline we are now using is coming from inventories. But at the present rate of consumption, these surplus stocks will be gone in two months."

Oklahoma Gasoline Tax Dips 10.83% in First Quarter

Special to NPN

OKLAHOMA CITY — Gasoline tax collections of $4,302,461.07 for the first three months of the fiscal year—July, August, September—10.83% less than for the same period last year, were reported by Oklahoma Tax Commission. The reduction in value of gasoline ration coupons effective in August will not be fully reflected in taxes until October, the commission said. Gross oil production taxes for the first three months totaled $1,876,940.22, a decrease of 14.18%.

License Fees Gain

Auto and farm truck licenses totaled $71,285.17 and commercial vehicle license fees aggregated $169,478.77. Most of the 33.14% gain in auto license revenues is believed to represent registration of vehicles of defense employes recently moved into the state, the report stated.

California Gas Sales Increase As Power Companies Buy

NPN News Bureau

LOS ANGELES—Natural gas sales in California for the first nine months of this year have reached record volume.

Six utility companies in the state which do 99% of the total business report that sales were 15.3% greater this year than in the first nine months of last year. Total volume sold was slightly in excess of 221 billion cubic feet.

While all categories of sales showed advances, the largest gain was in use of natural gas for generation of electric power. In the first nine months nearly 20 billion cubic feet of gas was used for this purpose, a gain of 149% over the like period of 1942.

As of September 30 this year, records show a gain of 68,932 domestic users, 320 commercial users, and 75 industrial users.

Gross revenues for the first nine months to the six utility companies selling gas were only up 6.7% over last year, however.

The Editor's Page

Army's Sneaking $134,000,000 into Canol Project Challenges Efficiency of All War Management!

THE STORY OF THE "CANOL" REFINERY, pipe line war production development of the U. S. Army way up in Canada near Alaska, as developed by the Truman senatorial committee on war operations last week, seems to be one of incredible mismanagement, lack of proper planning and of failure to consult with the arm of government—PAW—especially charged with supplying oil for the war.

The story told the committee by many witnesses naturally arouses the fear that if the other activities of the Army and its supply have been carried on in like manner, then this is only the first chapter of a long and startling tale. In fact, it may well be said that if this difficult-to-believe story is the first chapter, then the oil industry already has been treated to the preface which was the mess that existed in the Army's oil procurement section up to early summer and which was in the same supply department as this Canol project.

It was the same general, it seems, who casually and verbally committed the country to an expenditure of $134,000,000 for a small refinery and little production, who listened to many complaints as to his oil procurement before he finally moved to improve that activity, which he has very much.

This Canol scheme, according to the testimony, seems to have had an illegitimate birth. It was sired in some unknown manner within the secrecy of the War Department which has done its best to conceal its pregnancy and the resultant birth. The Army's only man with some refining experience is said to have expressed his repugnance so vigorously that he used the word "cockeyed." The Army's only other oil man, who also was let in on the secret, and who is skilled in oil production, testified as to how accurately he had forecast the small size of the Norman Wells field.

To make the story even worse, PAW Ickes testified that his organization only heard of the project by chance from contractors who had been called in to do the job. Great care had been taken to keep the secret from PAW, although it is charged with all oil activities for war.

As if this was not enough, the Army was reluctant to respond to Mr. Ickes's inquiries and when he offered the services of himself and his staff of recognized world-wide oil experts, the Army rejected them. Then Mr. Ickes sent in his objections to the scheme. He pointed out that the field is a small one and that all the aviation gasoline that this dinky and high cost refinery could possibly make in a whole year could easily be made in this country and transported to Alaska by a single fair sized tanker in only four trips, and that these trips would be quite safely made most of the way in an inland channel and, if submarines threatened, then the cargo could be put into a small pipe line and pumped the rest of the way.

PAW Ickes told the Army that it would only take 3 months, at most, to construct 800,000 bbls. of storage and build the small line while to do the job of drilling more wells, build pipe line and refinery that the Army had planned would take all of a year if not more. It now appears it will take at least 2 years.

PAW Ickes also protested the use of 130,000 tons of steel and other critical material at a time when the Army and Navy, to say nothing of the American public, needed them where they would produce the most oil per ton of steel and that certainly was not up on this Canol project. In this view of the futility of the Canol project, Mr. Ickes seems to have been joined by the opinions of the two participating oil companies, although there is little direct testimony on this at the moment.

PAW Ickes still thinks so little of the project that he says the $100,000,000 the U. S. now has in it should be junked in order to save some $34,000,000 more which will be needed to finish the scheme.

The unbelievable part is that all this was worked up by a few officers, was only discussed, says the testimony, verbally, was presented to the head of the supply division in a one-page letter by the refinery man who called the scheme "cockeyed," and then was launched on only the verbal approval of the general commanding the Army's supplies division.

If any business concern was found proceeding so casually on a matter of such importance financially and strategically, all the New Dealers in government and out would be piling down on that enterprise demanding that the business be taken away not only from the management but probably the stockholders as well and turned over to them, the government, the same government that on no study worthy of the name and on the nod of the head of one man, commits us to a costly project of little or no war value and to the detriment of the rest of the country's highly essential war producing and refinery program.

Field Was Tested and Found Inadequate

NOR DOES THE EXPLANATION of Under-Secretary of War Patterson add luster to the project. His testimony seems to cut a little this side of the truth in several particulars. He testified that the Norman Wells field is "large," whereas his own estimate of ultimate recovery is only a possible 50 to 100 million bbls. He also says that had it not been for the Army in this $134,000,000 adventure the field would not have been "discovered." Later he admitted the existence of the field had been brought to his attention by an Arctic explorer. The fact is the field was discovered, and tested by private oil enterprise 20 years ago and found to be small and to have little value such a great distance from market.

Mr. Patterson offered two alibis as to why he did not consult PAW Ickes and his organization of experts. Although PAW stumbled on this Army oil scheme a year and a half ago which, it now appears, was a full two years before it will be supplying any products even in its small way, Mr. Patterson testifies that he could not then have consulted PAW because the rush of the war would not permit of the "delay."

At another point in his testimony in regard to why the Army's "experts" could not have consulted PAW during the three or four months they said they "studied" the project, Mr. Patterson said they could not have advised with Mr. Ickes because his authority did not extend to oil outside the U. S. This statement is a flagrant disregard of the facts because, regardless of the precise wording of this or that letter, Mr. Ickes has, since he was first made Petroleum Co-ordinator, been charged with and has been co-ordinating the oil supplies for

READERS' comments and opinions will be much appreciated by Warren C. Platt, NPN's Editor and Publisher, Penton Building, Cleveland 13, Ohio.

all armies; he has been supplying all oil for Canada both for its army and its civilians, and he has been passing on plans and material for developing, producing and refining facilities with American capital and steel everywhere in the world.

Furthermore, during all this period of "secrecy," Mr. Patterson himself and a large number of his associates, both before and after his venture into oil producing and refining was discovered by PAW, have been in almost daily consultation with PAW on the problems of oil supply not only to our armies and Navy but to the armies of our Allies. Hence, keeping PAW in ignorance of and then out of this Canol project is most obviously from even Mr. Patterson's own words, a bit of arbitrary, undisciplined Army bullheadedness, yes, and stupidity. Had there been a real "general manager" over the whole war effort, this refusal of the Army to go along with the rest of the team undoubtedly would have been summarily dealt with.

Incidentally, one wonders what the War Production Board was doing all this time? Its experts testified last week against the scheme. WPB had to have knowledge of the project even right at the start, in order to allocate the metals and materials. Why did not WPB see that the Army plans lacked the approval of the only branch of goverment naving to do with oil supply and with the erection of new refineries and the inauguration of more drilling? Why did not WPB call in PAW if for no other reason than to protect itself against possible criticism for giving up material for an oil project that was not even known to the oil authority? There have been times when WPB has seemed a bit short on courage.

Even after the Army's little oil "secret" was discovered by PAW, and after a few thousand people knew of it from working on the project, the Army continued to hide the venture. It was the Canadian government that at last released stories on it a few months ago. Those stories unloosed tongues until finally enough information drifted to the Truman committee on the conduct of the war to warrant an investigation. The committee intends to make a quick report and undoubtedly it will be severely critical of the Canol project for the chairman was quoted at the close of the hearings as saying that the Army had failed to justify the scheme.

This Canol investigation is further evidence of the need for Congress continually to investigate the operations of both the war and of all government agencies in the furtherance of good management and the rights of the people.

The Truman committee might pursue the alternative to the Canol project by asking PAW what it would have done toward increasing our deficient oil supply if it had been given $134,000,000 and the steel and other equipment the Canol project consumed. What would that metal have meant in additional aviation or butadiene plants? How much further along would our supply of 100 octane gasoline have been, and for which both Army and Navy are now clamoring, had that equipment been given to a refinery under way in this country? How many wells could have been drilled in far more productive territory with the money and steel? Even at a cost of $100,000 per well for wildcatting, at least 1340 additional holes—half of our wildcats—could have been put down which would probably have produced far more oil than the dozen wells drilled in Canada.

Centralizing Authority Seems Not Sufficient

LAST WEEK we asked in an editorial a question which goes direct to the heart of the Administration's policy of management—or mismanagement, if you will. That question was what difference will it make putting all authority over the oil industry and its prices under PAW, as is proposed in the pending Disney bill, if the White House continues to reach down and make decisions on all matters that it chooses and regardless of the advice of its experts who do know what they are talking about, such as in PAW?

We could now add to that question, what difference will it make to thus concentrate authority when any other department, such as the Army—and this would go for the Navy and Lend-Lease—can enter the oil business without consultation with PAW or any other department and take from PAW materials that it vitally needs in carrying out its lawful and well-thought-out plans for supplying all armies and this country with vital petroleum products?

Evidently what Congress must do is to impose a system of efficient management on this government, rather than tackle it piecemeal, and then it will have to stand constantly on the alert to see that the plan is carried out.

And Congress will have to put plain limits on the use of the taxpayers' money.

Otherwise we are liable to have "Canol projects" spring up all over the world, paid for out of Lend-Lease or the Petroleum Reserves Corp. or the Import-Export Bank of Jesse Jones. We may find "Canol projects" in the U. S.?

And that is just what oil and other business men are afraid of.

Snags in Oil Restrictions Test Negotiating Tact of All Factions

(*Continued from p. 8*)

allowed we are sure he will open the door to them. And he has been diligent in his efforts to get the industry within his jurisdiction to reach amicable agreements.

It should be entirely possible to settle not only the east coast but the middle west situations by negotiations providing all factions are propery represented in the negotiations. Both Directors Dodge and Vandeveer can do a good job of acting as moderators of the negotiations.

But in fairness to the negotiators and to the whole industry and the public, all should be given all the facts regarding the future military requirements from this country's supply of petroleum. It is not fair, when the military authorities do have ideas at least of their future needs, to give the information to the industry and the public in driblets, thus forcing the industry to be constantly going over the same ground in its calculations in order to revise them. The military authorities know exactly what petroleum using equipment is now being made and is under order. The military by now should have a pretty good idea of the probable extent of use of this equipment, from which the probable requirement of petroleum products can be fairly estimated. To this needs to be added quantities to fill storage.

There is no question from all the information the military authorities have made public, to say nothing of what probably has been gathered by spies, that Hitler has a pretty good idea of the amount of equipment he will have to fight. Hitler knows that we have the equipment and he knows that we are going to use it to the utmost; in fact he may be a better judge of what that utmost may mean than we are.

So the military authorities are not hampering Hitler by keeping their petroleum estimates secret. In fact, they are aiding Hitler to the extent that such secrecy interferes with the oil industry's doing the best job that has to be done to supply those products. The oil industry has been troubled enough by the faulty estimates and the secrecy and the mismanagement of petroleum requirements by the military authorities. It is time that those authorities do a better job of cooperating with the industry and if they do not want to do it, the men of the oil industry, who today are so involved in the complexities of making restrictions work, should ask Congress to make the military authorities give them the facts.

800,000

Practically every major and independent oil company knows this Leland curb pump motor—and most of them specify it. Millions of station attendants operate it—and find it dependable. Over 800,000 sold, the majority still in service. When a curb pump is replaced, equip it with a *Leland Motor.*

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LETTERS

Applauds Editorial on A.P.I.

FROM: W. T. Holliday, president, Standard Oil Co. of Ohio. To: The Editor

I want to compliment you for your editorial in this week's "NATIONAL PETROLEUM NEWS" on the American Petroleum Institute. I think it is one of the "happiest" editorials you have written.

For several years the A.P.I.'s board of directors has done little but meet once a year and elect officers, and if one considered the institute only from watching the meetings of the directors and executive committee, one might wonder why the institute is being continued.

When that thought first came to me, however, I realized that what the institute is doing is really conducting a great university. It has withdrawn entirely from the field of economics but is doing a tremendous job in science.

I think your editorial needed to be written in order to remind people of what has become the prime activity of the Institute. Co-operation in the industry in all legitimate lines now follows simply as an inevitable by-product of the activities described in your editorial. Thanks and congratulations.

Changes Mind on Crude Boost

FROM: Julius Malkemus, President, Oil Terminals Corp., Louisville, Ky. To: The Editor.

Our Government's position on "Hold The Line" was not the determined and sincere thing I thought it was as evidenced by the surrender to John Lewis.

So, it seems to me that the oil industry forthwith must compel Washington to choose a method of getting oil in sufficient quantity to serve the essential civilian needs as well as the military. The accountability and responsibility is theirs and we are derned fools if we permit the public to think it is our fault. If only recommendations are made to Mr. Ickes then someone will distort it to the public like that squawk when the original 35c per barrel increase was sought by this same PAW. The story must be told to the public and the aid of the public's constitutional representatives sought. No large company executive wants this industry to wind-up as a monopoly. The large companies are hesitant to quarrel with a war going on, so they will need prodding for this battle in defense of the industry and their own companies.

You have not had illusions about the situation. This is written to thank you for your past militancy and to hope that you will continue to keep us awake; to get us fighting mad. We need action if the war effort is not to suffer and our future put in a fog.

Deplores Survey Failure

FROM: Henry B. Van Dyne, president, Van Dyne Oil Co., Inc., Troy, Pa. To: The Editor.

Apparently the axiom "The Lord helps them who help themselves" does not carry much weight with the gasoline distributors with marginal contracts. I refer to the Petroleum Jobber Questionnaire PAW Form 21 mailed to jobbers several months ago in which they were asked for confidential comparative data on their profits or losses for the three months ending June 30, 1941 and June 30, 1943. . . . .

I do not claim, that if practically all of the jobbers had co-operated on this survey, an increase in margin surely would have been granted, but I do claim that if a large majority of the jobbers had taken the slight amount of trouble necessary to return the questionnaire, there would at least have been some chance for relief. At any rate it would have been worth the effort. . . . .

Humble's Scrap Program Yields Equipment For Use in War Construction Projects

Special to NPN

HOUSTON—Humble Oil & Refining Co.'s salvage program is now a two-pronged war drive—supplying re-usable material for Plancor and Defense Plant project and its own use as well as scrap metal for steel mills.

The company furnished $296,000 worth of re-usable material and equipment to war construction jobs in the first two months of this year, and $988,412 worth last year. The discounted value of used but serviceable items made available to it and others in 1942 amounted to $7,791,400, representing an original estimated value of $11,986,770.

Well organized after operating for a number of years, Humble's salvage program is handled with an eye on company-wide operations. In the company's larger plants, salvage selection, collection and segregation is a day-to-day consideration. In smaller operating centers, a special salvage committee makes periodic surveys and each item of equipment or material under question is examined and passed upon. Company plans of conversions, substitutions or construction are factors influencing committee decisions.

At times, company programs have necessitated special decisions on large items. A reduction of Humble's drilling program left a number of drilling rigs idle, for example. A special meeting of management and engineers was called, and each kind and type of equipment was considered. As a result, undesirable equipment was discarded and several hundred tons of scrap was thus released.

Normal replacement of worn or broken parts of equipment in service provides about 30% of Humble's scrap. These items are accumulated within each plant and district and disposed of along with scrap from other sources as soon as the pile amounts to 7000 lbs. or more.

Fifty percent of the company's scrap comes from the abandonment of units, wells, leases and plants. The production department provides the greatest amount of re-usable salvage (amounting to $6,623,944 in 1942). This compares with $417,300 from the refining department, $24,289 from the crude oil department, and $725,867 from Humble Pipe Line Co. The remaining 20% of Humble's scrap comes from discarding obsolete materials and equipment found on proper inspection to be of no further use due to type, model, kind or other feature.

In its day-to-day salvage operation, Humble sorts its ferrous scrap only as to cast, light (compressible), and heavy unprepared, particularly where the largest quantities are handled, and it is sold as such. High wages of skilled oil workers prevents more detailed segregation. In handling non-ferrous scrap and alloyed items, however, a more complete grading is employed.

In moving scrap to accumulating bins, effort is made to avoid special hauls. Usually the scrap moves out on a backhaul.

Usable nuts and bolts are sorted for size by Humble workers. Anything left will be shoveled into a bin to await the accumulation of a truck load of scrap

In a Humble shop, a reclamation workman assembles some of the odds and ends retrieved from the scrap heap. Use It or Scrap It is the watchword

Salvage from well sites on Humble leases constitutes a large part of Humble's total scrap tonnage. Everything from paper butts to choke valves goes

Orlin Emerson (left), president of the Emerson Oil Co., an independent jobber at Waukesha, Wis., credits this dependable International with "wonderful performance" in serving a large farm trade area in southern Wisconsin.

"WONDERFUL PERFORMANCE without any trouble to speak of"

Good Care and INTERNATIONAL SERVICE Will Help Keep Your Trucks Rolling, Too

"Wonderful performance without any trouble to speak of" is the kind of endorsement that owners consistently give their International Trucks when they are well cared for and well serviced.

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International Service—always an important part of our Company's truck program—is more vital today than ever. International dealers and branches from coast to coast are pledged to help keep your trucks rolling. *That's a wartime must.* Trained servicemen, working with precision tools in well-equipped shops, are your best allies in the fight to keep every available truck at work.

If the manpower shortage has stripped you of the servicemen who looked after your fleet in peacetime, arrange with the nearest International dealer or branch now for a program of SCHEDULED SERVICE. Such a vigilant program will eliminate many "nuisance" breakdowns and save you many valuable truck-use hours.

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Give War Bonds for Christmas — the Present with a FUTURE

INTERNATIONAL TRUCKS

Los Angeles Is Fogged By Butadiene Plant; But It's "All Clear" Now

NPN News Bureau

LOS ANGELES—With a special priority for fully enclosed heat exchangers and the assertion by U.S. Rubber Director Bradley Dewey that, "you can call me a bum, and I will close down the plant myself" if the situation is not corrected by Dec. 1, Los Angeles has returned to normalcy again after a hectic three-month battle in which it was claimed that a butadiene plant was "stinking up" the sunkissed City of the Angels.

Apparently there is still some doubt as to whether the butadiene plant is entirely responsible for the eye-smarting haze which hung over the city and caused all the trouble. However, the Southern California Gas Co. operator of the plant for Rubber Reserve, is forestalling all possible claims by constructing fully enclosed heat exchangers to replace the open type.

At this writing 30 of the 45 exchangers have been installed and it is believed by the company that the plant will be ready for operation about Dec. 15. It has been closed down since Nov. 9 because of the controversy.

To understand the butadiene controversy it is necessary to go back about three months. It was a hot and sultry day when a white mist, almost like a fog blanket, settled over Los Angeles. The police department and the county health officials were flooded with calls complaining of smarting eyes and nose and throat troubles attributed to by the haze.

Scouts Scent Fumes

The city sent out a scouting party and next day the report was made that peculiar atmospheric conditions had brought fumes from the open air heat exchangers of the butadiene plant.

Once the source of the trouble was found, the City Council and the mayor brought pressure to curtail operations of the plant. When this did not end the trouble suit was filed to close the plant entirely.

The gas company tried to correct the situation by using chemically treated water in the exchangers. This seemed partially to clear up the fumes but not enough to prevent the citizens from going to work each morning with tears in their eyes.

On the amusing side of the so-called "Butadiene Incident" was the fact that on several mornings when the eye smarting haze came over the city and the citizens started their usual barrage of complaints it was found that the rubber plant had been shut down for several days.

In spite of this, however, the city went ahead and filed suit to shut down the plant. The legal action brought Rubber Director Dewey flying to Los Angeles.

He told the city fathers that the fumes were the first the government had encountered in its synthetic plants, but that the trouble could and would be corrected by the new heat exchangers.

Col. Dewey also told the councilmen that during November he expected somewhere between 35,000 and 36,000 tons of synthetic rubber would be made in the U.S. Even if this figure were reached it would be 35,000 tons short of military needs alone, the colonel said.

When Col. Dewey finished councilmen adopted a resolution rescinding the city's injunction suit against the plant and the battle was ended.

Briefs from Week's News—

Standard of Jersey Paying Special Employe Benefit

NPN News Bureau

NEW YORK—Standard Oil Co. of New Jersey is distributing a special contribution totaling approximately $3,300,000 to its employes and those of its eligible domestic affiliated companies, including nearly 5000 now on leave with the military service. The funds are being paid to trustees of the Employe Thrift Fund by domestic affiliated companies which are eligible to take such action and will be credited to employe accounts.

In addition, the company and its affiliates make regular payments of contributions based on the extent to which each employe participates in the Thrift Fund. Regular contributions totaled nearly $6,000,000 for the year ended June 30, 1943. Under the plan the employe may deposit up to 13% of his current pay to which the employer adds an amount equal to the first 3% plus half of the balance of the employe's deposit. Since its inauguration in 1936, employe and employer contributions have exceeded $110,000,000.

Union Oil To Widen Territory

NPN News Bureau

LOS ANGELES — As a result of its purchase of the Glacier Production Co., Cutbank, Mont., the Union Oil Co. of California plans to extend its marketing territory into Montana and Idaho territories. Involved in the transaction were 90,000 acres of land, 3300 b/d of production and a 4500 b/d refinery.

Army Demands Further Cut in 80-Octane Use by Posts in U. S.

NPN Staff Special

WASHINGTON — The Army is intensifying its efforts to reduce consumption of 80-octane all-purpose military gasoline in the U. S. to the absolute minimum.

Use of the all-purpose fuel already has slackened off sharply in this country, but an even steeper decline is expected soon as the result of the determination of the Fuels and Lubricants Division to go over the stated requirements of all posts, camps and stations with a fine tooth comb before allowing 80-octane to be used.

Under a recently-adopted policy, NPN learns, no ordering agency in the continental U. S. will be permitted to procure 80-octane unless it first submits positive evidence of need, backed by a statement listing the particular equipment said to require this grade of motor fuel. Before any claim is allowed, statements will be checked here against ordnance equipment records.

First official announcement of the policy came from the Fuels and Lubricants Division in a press release. After telling all about 80-octane for 1000 words or more, the release concluded:

"The Army realizes that its use of large volumes of 100-octane gasoline for aircraft and of 80-octane motor fuel will result in reducing the quantity of high-octane gasoline available for civilian use. The Army plans to confine its use of this precious gasoline to the minimum required for combat and necessary training purposes. Where it is possible to use the lower grades of gasoline, every effort will be made to do so. For example, passenger automobiles and general purpose vehicles used for Army activities in large cities will use gasoline no better than that available for civilians."

Reduction Already Made

This does not mean that the Army is only just beginning its effort to reduce consumption at domestic posts, camps and stations. On the contrary, the effort has been under way for some time, with the result that during the last three or four months there has been an appreciable falling off in amounts used, according to Army spokesmen who are backed up as to this by PAW officials.

Up to now, the principal reduction in on-shore use has been achieved in the Atlantic seaboard states comprising PAW District 1, where the number of posts qualified to receive 80-octane gasoline has been whittled down to a minimum. The intention is to apply the same process to all posts.

The Army release describes 80-octane as the single standard combat gasoline for all Army vehicles, from ¼ ton trucks to tanks, operating under temperature conditions ranging from zero to extreme heat. Development of the fuel (U. S. Army Specification 2-103B) was a direct

outgrowth of the new problems that arose with the entry of this country into the war, according to the statement, which added:

"It was recognized that requirements for large amounts of aviation and motor vehicle fuels would result in the de-grading of civilian gasoline as the war progressed, and that in any case overseas operations would have to be carried out without the climatic and seasonal control of gasoline so effectively taken care of by the petroleum industry in the past.

Flexible Supply Precluded

"The requirement that the exact area and the time of the year of consumption be known without question every time a procurement of gasoline was to be made, precluded a flexible supply system in the theaters of operation. It also made it difficult for the War Department to re-route gasoline shipments in case of emergency, because a gasoline designed for one area might be used under totally different conditions in another . . .

"The importance of the right type of gasoline for mechanized equipment cannot be exaggerated. Gasoline which is specifically designed for winter use is dangerous in summer or desert operations, as a vapor-locked and stalled tank makes a fine target. Furthermore, the gasoline must be sufficiently stable not to gum under long storage. . . .

"The new standard specifications provide a single fuel that insures good operation without vapor-lock at high atmospheric temperatures as well as good starting and short warm-up periods at moderately low temperatures.

"In actual practice, the new specifications do not represent any substantial increase in the quality of Army fuel, but rather a standardization into one fuel of two types that were supplied civilian trade prior to the entry of this country into the war when it was possible to change grade with the seasons."

Army Revamps Grease, Lubricant Bids

NPN News Bureau

WASHINGTON—Abandoning present purchasing methods, the procurement division of the Treasury Department mailed out this week invitations for bids on supplying the Army's 1944 automotive grease and gear lubricant requirements at posts, camps and stations in continental U. S. Procurement plans to open bids about Dec. 15.

Separate single awards, one covering all items of greases and the other all items of gear lubes, will be made for each of 48 states, contractor to furnish all Army's grease or lubricant requirements within a particular state.

Estimated total automotive grease requirements is 10,000,000 lbs., gear oils demand 6,250,000 gal.

Decision to throw supplying of 1944 requirements open to competitive bidding means abandonment of methods under which both products now are being purchased. On-shore gear lubricant requirements for the period July 1, 1943 to end of year are being bought under contracts negotiated by Army with seven companies; automotive greases being purchased on multiple contract award basis. Prior to July 1 gear lubricant purchases also were on the latter basis.

The Procurement division mailed out 500 separate bid invitations in an effort to reach all suppliers. Distribution facilities will be considered in making awards.

The invitation allows collective bidding, permitting suppliers who individually don't have adequate state coverage or plant capacity to combine resources so as to quote on any state or group of states. Those who group together, however, will have to select one of their number as the bidder, and to act as their contractor, if the bid is successful.

The bidder must quote price on all grades of all greases and all lubricants, as the contractor will have to furnish all grease or all lubricants requirements in the particular state.

Gear lubricants will be purchased against U. S. Army Specification 2-105, dated Sept. 10, 1943. Auto greases will be purchased against current issues of Army specifications 2-106, 2-107, 2-108, 2-109, and 2-110.

Spends $60,000,000 Monthly for the Army

NPN News Bureau

NEW YORK—A former Shell Oil Co. purchasing agent is now performing that same job for the Army, and the volume of the purchases of his department have run as high as $60,000,000 a month. He is Col. A. K. Eaton, chief of Military Supply Division of the North Atlantic Division, Corps of Engineers. Col. Eaton was with Shell from 1929 to 1942 and was the company's purchasing agent for 12 years. Since going on active service with the Army last June he has held three purchasing posts. In addition to his present job, he was chief of the contract branch of the purchasing division of the Army Service Forces (formerly the Services of Supply), and was on special survey assignment with the technical services.

Col. A. K. Eaton

Col. Eaton's present organization is of interest to petroleum men since, as he says, "Six of the top positions are filled by men who have had a total of more than 100 years experience in the purchasing departments of three of the largest oil companies. They are practical business men who know the answers and talk the industry's language.

"The purchasing of engineering military supplies for the Army is being handled by experienced buyers," Col. Eaton says. "They are for the most part men who have had responsible purchasing jobs in private industry and therefore are handling their Army assignment with the same business acumen that they exhibited in private life."

Col. Eaton's purchases run from heavy bridge building equipment to complete oil refineries. He is in wholehearted accord with the provisions of Public Law 603 which directs the placing of all suitable business with small plants. "The policy of the Army engineers", he says, "is to have all procurements screened by the Small Plants Corp. to determine if they can be offered to small plants. The average value of the contracts we place approximates $20,000 and a great portion goes to the smaller plants."

Col. Eaton says that any potential supplier can feel assured that his quotation will be treated with strict confidence and the award will be made to the bidder offering the best proposition. "I believe," he says, "considering the necessity for speed, inadequacy of existing installations to supply merchandise, volume of business involved and newness of the purchasing operations, that never in the history of American business has the efficiency of our Army purchasing and contract officers been equalled."

Ceilings Spelled Out For More Refineries

NPN News Bureau

WASHINGTON—Refiners in certain designated areas of Ohio, Indiana and Kentucky have received from OPA's petroleum price branch copies of a tentative schedule of maximum prices on their shipments of petroleum products to Michigan and to District 1.

Schedule is a new application of OPA's policy of establishing schedules of specific ceilings, uniform for all refiners, in spots where new movements have been compelled by wartime dislocation of transportation and where "freeze" formula of RPS 88 has left refiners with hazy and widely varying ideas of what their ceilings should be. Spell-outs have already been made for inland refiners of District 3 (*see NPN, Nov.* 17, *p.* 9, *and Sept.* 8, *p.* 26) and for refiners of certain areas of Kansas, Missouri, Illinois and western Indiana (*see NPN, Nov.* 10, *p.* 24).

Text of explanatory letter:

Attached hereto is a proposed schedule of maximum prices covering f.o.b. shipping point sales from the designated Indiana, Kentucky and Ohio refinery areas to ultimate destinations in Petroleum Administration for War District One and Michigan.

Petroleum Administration for War District I

As you know, very few, if any, movements of this nature occurred during the base period. Consequently, such ceilings as presently exist for the products in question were established as the result of the application of the freeze formulas in Revised Price Schedule No. 88, and were generally based on the individual seller's sales to destinations other than District I. The result is that ceilings vary considerably even at a given shipping point. Inequities to buyers and sellers have occurred. There is, as well, a lack of clarity in such ceilings as they affect the Defense Supplies Corporation Compensatory Plan.

Consistent with our policy of establishing simplified dollars-and-cents maximum prices wherever feasible and to provide equitable ceilings for all participants in the District I movements, we propose to establish the attached schedule on, or about, Dec. 6, 1943.

The ceilings were developed after a thorough study of (1) ceiling price information which you filed with us, (2) the competitive position of the various areas compared to adjoining areas, (3) factors of local competition within the given price area, and (4) prices actually charged by sellers thus far for District I movement as reflected by prices reported to the Defense Supplies Corp.

You understand, of course, that in developing ceiling prices we are limited by the standards which have been established to prevent inflation. We have made a conscientious effort to develop these prices from information currently available without requiring additional detailed information from the various sellers. We believe the proposed maximum prices are fair and equitable.

For reasons of possible future developments in supply, we have incorporated maximum prices for shipments to Michigan in the schedule in order to facilitate product movement should the necessity arise. We realize that shipments from any point except Toledo would be unusual.

Members of our staff have met and consulted individually with a number of sellers regarding the proposed schedule. If you consider that the maximum prices as outlined are not realistic from a standpoint of fairness and effectiveness and you would like to come in and present your views, we shall be available for discussion and consideration of the schedule with you all during the weeks of Nov. 22 and Nov. 29. Should you desire to do this, we suggest that you telephone or wire the date and time most convenient for you. Although the schedule will not be issued on Dec. 6, it is presently planned that it will be released by this Branch to the Federal Register as soon as possible following that date.

Very truly yours,
O. D. Judd
Price Executive, Petroleum Branch

Text of proposed schedule for Ohio, Indiana and Kentucky:

F.O.B. CEILING PRICES FOR SHIPMENT TO ULTIMATE DESTINATIONS IN PAW DISTRICT ONE & MICHIGAN FROM DESIGNATED INDIANA, KENTUCKY AND OHIO AREAS

(ALL FIGURES IN CENTS PER GALLON)

	Price Area G	Price Area I	Price Area J-1	Price Area K-1
GASOLINE				
80-82 Oct. A.S.T.M. & Ethyl Grade	8.375	8.625	8.75	8.75
72-74 Oct. A.S.T.M.	7.375	7.625	7.75	7.75
58-62 A.S.T.M.	6.625	6.875	7.00	7.00
DISTILLATE FUEL OILS				
41 A.P.I. gr. and above W. W. Kerosine	5.5	6.125	6.25	6.25
No. 1 P. W. Distillate, Range Oil and No. 1 Fuel Oil	5.375	5.625	5.75	5.75
No. 2 Fuel Oil	5.25	5.375	5.50	5.50
No. 3 Fuel Oil	5.125	5.25	5.375	5.375

Price Area G comprises the counties of Union, Henderson, Davies, Hancock, Breckinridge, Meade, Hardin, Bulitt, Jefferson and Oldham in Kentucky; and the counties of Posey, Vanderburgh, Warrick, Spencer, Perry, Crawford, Harrison, Floyd, and Clark in Indiana.

Price Area I comprises the area within a radius of 25 miles of Indianapolis, Indiana, the counties of Hamilton, Clermont, Brown, Adams, Scioto, Lawrence, Gallia, and Meigs in Ohio; the counties of Boone, Kenton, Campbell, Pendleton, Bracken, Mason, Lewis, Greenup, and Boyd in Kentucky.

Price Area J-1 comprises the counties of Allen, Hancock, Lucas, Putnam, Wood, and Licking in Ohio.

Price Area K-1 comprises the counties of Cuyahoga, Lorain, Medina, Summit, Stark, Portage, Geauga, Lake, Ashtabula, Trumbull, Mahoning, Columbiana, Jefferson, Belmont, Monroe, Washington, and Athens in Ohio.

C.I.O. Loses NLRB Election At Humble Baytown Plant

HOUSTON, Tex.—The Baytown Employes Federation, independent union holding a contract as the bargaining agency of the Humble Oil & Refining Co. plant at Baytown, won a 2 to 1 victory over the International Oil Workers union (C.I.O.) in a National Labor Relations Board election Nov. 24.

Agricultural Engineers To Discuss Lubes

NPN News Bureau

CHICAGO—At the fall meeting of American Society of Agricultural Engineers, to be held at the LaSalle Hotel here Dec. 6 to 8, Dr. M. D. Gjerde of Standard of Indiana, will speak on "Developments in Engine Lubricants," and Thomas H. Risk, director of refining division, Ethyl Corp., will discuss tractor fuels.

After the talks an open forum will be held and representatives of leading engine manufacturers will sit as a panel to answer written questions on fuels and engines.

Engine experts scheduled are Chief Engineers Earl Ginn, of Continental Motors Corp., J. B. Fisher of Waukesha Motor Co., A. F. Milbrath of Wisconsin Motor Corp., and D. W. Latta of Hercules Motor Corp.

A meeting at 9:30 A.M. in the hotel's Illinois Room will view power and machinery for the farms program. Speakers will be George Krieger, director, farm equipment division, WPB, who will talk on the farm machinery situation; F. W. Duffee, chairman, agricultural engineering department, University of Wisconsin, and A. J. Schwantes of the agricultural engineering division, University of Minnesota, both of whom will discuss "Interchangeable Power Units for Farm Machines."

"What New Farm Machinery Developments Are Needed?" will be debated by E. G. McKibben of the agricultural engineering department of Michigan State College, A. P. Yerkes of International Harvester Co., and E. J. Baker, Jr., editor of *Farm Implement News.*

At 7 p.m. Dec. 7, a meeting of extension agricultural engineers will discuss "A Program to Help Farmers Utilize Fully Their Farm Machinery, Equipment and Structures."

Automotive Engineers Schedule Symposium on High Octane

NPN News Bureau

NEW YORK—The metropolitan section of the Society of Automotive Engineers will present a symposium on "High Octane Fuels" at Hotel Pennsylvania here Dec. 2. High octane gasoline production for war and postwar uses will be discussed by Bruce K. Brown, assistant deputy PAW and Dr. P. Barnard, director of research of the Standard Oil Co. of Indiana.

Charles A. Chayne, chief engineer of General Motors Corp., Buick Motors Division, will talk on "Potential Utilization of High Octane Gasolines in Engine Development." Discussions will be led by R. P. Russell, executive vice-president of Standard Oil Development Co.; J. F. M. Taylor, vice president in charge of refining, Shell Oil Co., and Max M. Roensch, chief of engine development section of Chrysler Corp. George Freyermuth of Jersey Standard, the society's vice chairman for fuels and lubricants, will be chairman.

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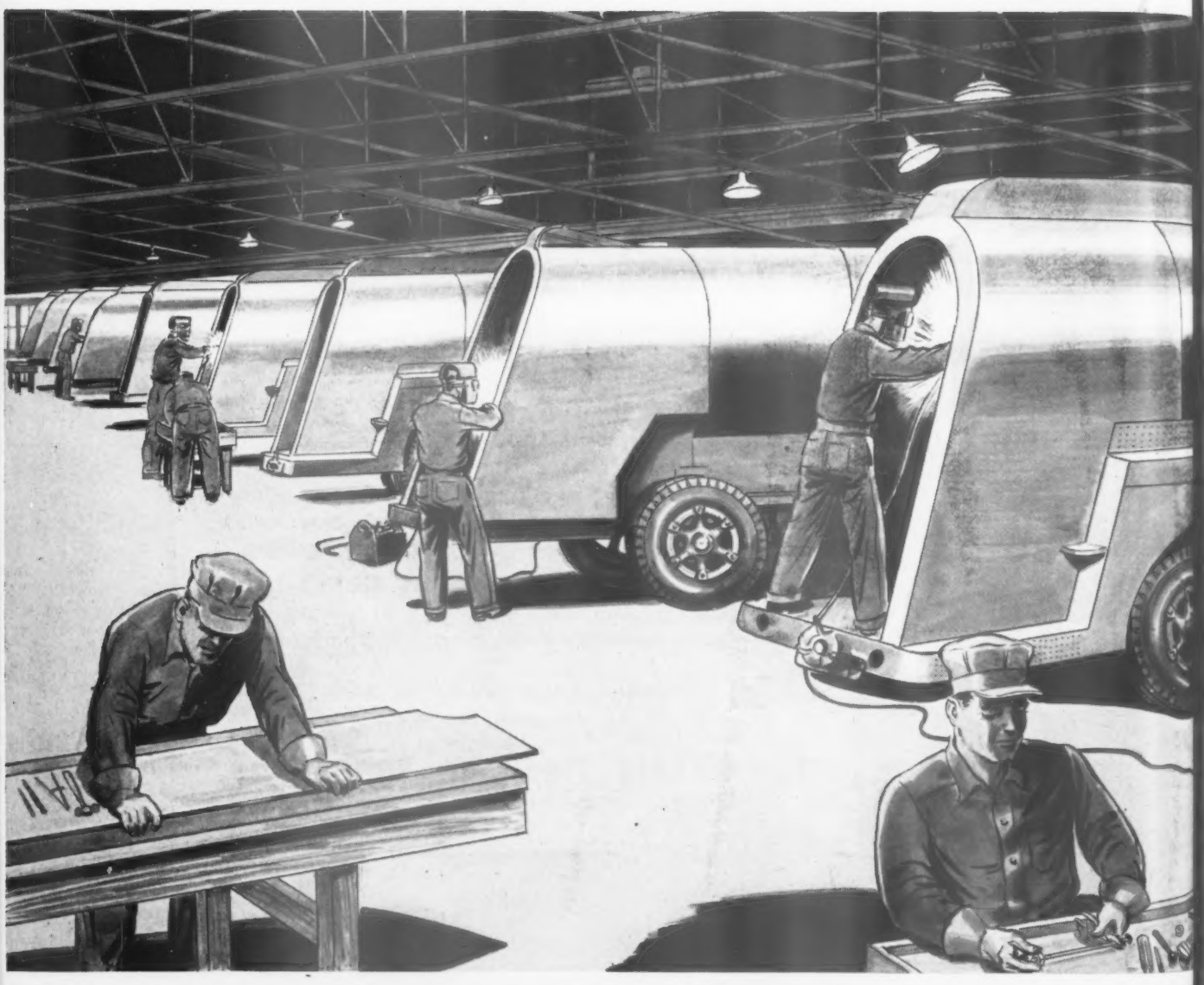

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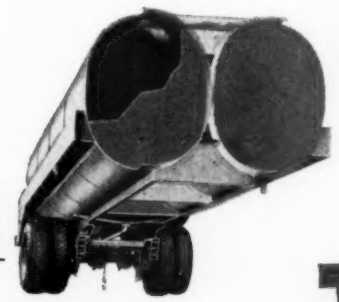

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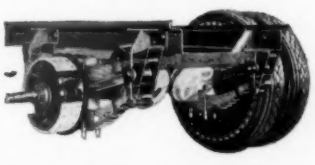

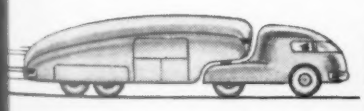

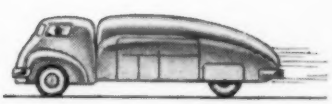

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Briefs from Week's News—

Big Inch Complete, Tank Cars Still Load at Norris City

Special to NPN

CINCINNATI—The Big Inch has been completed, with all pumps and other equipment installed ready to handle a capacity load of 300,000 b/d of crude oil from Norris City, Ill., east since Nov. 17, B. E. Hull, vice president and general manager of War Emergency Pipelines, Inc., said Nov. 26.

But the railroads continue to shove 150 to 225 empty tank cars up to the Norris City loading racks daily and rather than let them stand idle or lose time being taken elsewhere for loading, Mr. Hull said they were loaded at Norris City and sent east again.

"I hope the ones we got out there today are the last ones," Mr. Hull added, "as we can now handle the full amount of crude oil in the pipeline to the East."

It is understood here that ODT handles the assignment and routing of all tank cars.

FPC Schedules Hearing Date On Consolidated's Appeal

NPN News Bureau

WASHINGTON—Hearings on Consolidated Gas Utilities Co.'s applications for authority to construct additional facilities in Texas and Oklahoma have been set for Dec. 10, here, by the Federal Power Commission.

The hearings have been scheduled for 9.45 a.m. in District Court Room, U. S. Post Office, on the company's applications to construct and operate a compressor station near Twitty, Tex., a 5600 ft. gas transmission pipeline to interconnect existing facilities near Blackwell, Okla., and 2986 ft. of 8.625-in. pipe to replace approximately 4600 ft. of 6.625-in. pipe in Grant County, Okla.

OPA'S December Auto Ration Is 15,500 Cars, Lowest Ever

NPN News Bureau

WASHINGTON—A quota of 15,500 new passenger cars for rationing in December—the lowest in almost 2 years of rationing—was announced this week by OPA.

The December quota represents a cut of 25% from the November quota of 20,600 cars which, in turn, was a reduction of almost 35% from the previous month's figure.

Keep 'em Rolling—

ODT Offers 10 Points to Conserve Manpower, Keep Hard-Pressed U. S. Transport Rolling

NPN News Bureau

WASHINGTON — A 10-point manpower program designed to assure enough manpower to perform the automotive repairing and servicing necessary to keep the nation's motor transport system in operation was announced last week by ODT.

Prepared by the transport personnel division, with the co-operation of its automotive maintenance manpower committee, the program sets up a pattern for integrating efforts of the government with those of the industry to secure needed maintenance manpower, ODT said. The program has the approval of the War Manpower Commission.

Program for Varied Agencies

In keeping with the decentralized, small-shop character of the industry and with the decentralized administration of government manpower agencies and of ODT's division of motor transport, the program approaches the manpower problem through co-operative action on the local, community basis on which, ODT officials said, excellent results in the training of mechanics already are being accomplished in more than 100 cities through the co-operation of the U. S. Office of Education and other federal training agencies.

Local employer and employe groups, officials of ODT, WMC and its component training and recruiting services, automotive manufacturers and trade associations, and local associations or groups of dealers, garages and service men will do these things, ODT said:

1. Organize co-operative manpower programs on a community-wide basis for all types of automotive maintenance establishments;

2. Make community manpower inventories of all classes of automotive maintenance establishments;

3. Develop and adopt war time service standards and practices that will conserve automotive maintenance manpower while providing for the needs of the community;

4. Adopt a full wartime work week in automotive maintenance establishments in any community faced with a shortage of maintenance workers;

5. Confer with local Selective Service officials and seek the approval of deferment and withdrawal schedules based upon the community manpower inventory and related to the needs of the community for automotive maintenance services;

6. Take all possible steps to stabilize employment in maintenance establishments.

7. Develop a realistic recruitment

TANKER CAPTAIN DECORATED. For successfully standing off a torpedo attack by a U-Boat in the Gulf of Mexico, Capt. Peter J. Sigona, skipper of a Gulf Oil tanker, has been awarded the Merchant Marine Distinguished Service Medal. By clever maneuvering of his ship, Capt. Sigona dodged five torpedoes fired at his 75,000 bbl. cargo of Navy fuel. A sixth glanced off the bow, did some damage. Capt. Sigona is shown receiving the award in Gulf offices in New York from Capt. Giles Stedman, superintendent of the U. S. Merchant Marine Academy, while Willard F. Jones, general manager, Gulf marine department, looks on. Capt. Sigona was born in Pazzallo, Sicily, came to the U. S. in 1918 at 16, started with Gulf as an ordinary seaman. An uncle was a former Gulf oil tanker captain. Captain Sigona has taken tankers all over the world and was in five previous submarine attacks

program based upon available classes of workers and geared to the minimum needs of the community for maintenance services;

8. Establish practical training programs to develop inexperienced recruits into competent helpers and to upgrade helpers to mechanics;

9. Within the limitations of national wage stabilization policies and programs, adjust wages of maintenance employes so as to stabilize employment and increase productivity of present employes;

10. Promote the co-ordination of community automotive maintenance facilities so as to eliminate any avoidable waste or under-stabilization of manpower.

"Stockpile Diminishing"

In a statement on the program, ODT Director Eastman said:

"The national stockpile of motor vehicles has been steadily diminishing and will continue to diminish for the duration of the war . . . It is therefore imperative that automotive vehicles be kept in usable condition as long as possible.

"Because of this necessity, motor vehicle transportation depends more than ever before upon careful maintenance . . . The motor transport program of the ODT is concerned, to a very important extent, with the conservation of motor vehicles and of the transportation service they perform.

"The seriousness of the manpower situation in the automobile maintenance industry requires the concerted action of the industry and the government."

Final Valuation Is Fixed On Socony-Vac Carriers

NPN News Bureau

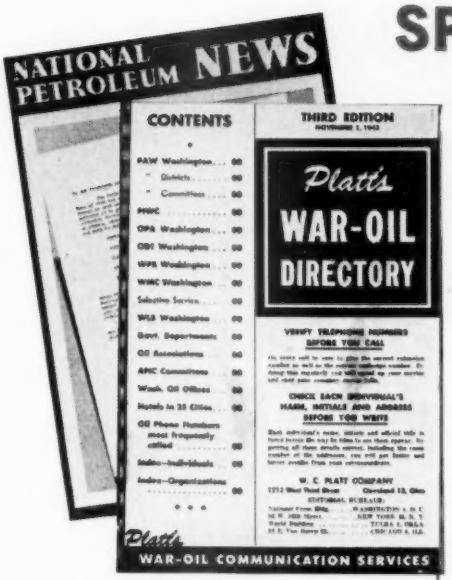
WASHINGTON—Final valuation for rate-making purposes of the properties of Socony-Vacuum Oil Co., Inc. (Midland division and New York and Pennsylvania lines), owned and used for common carrier purposes, totaled $5,125,000 as of Dec. 3, 1939, and of property used but not owned, $24,133, according to recent order of Interstate Commerce Commission.

By a previous order of Feb. 19, 1943, entered in valuation Docket 1268, ICC completed tentative valuation as of Dec. 31, 1939, of the properties of the carrier and notice was served on it and other interested parties. Socony-Vacuum then filed protest against the tentative valuation and a hearing was assigned but later the carrier advised the commission by letter of its desire to waive the hearing and an order was entered making the tentative valuation final.

Week's Truck Quota Is 1349

WASHINGTON—A net total of 1349 vehicles was released under WPB's truck rationing program during the week ended Nov. 20, it was reported last week, comprising 379 light, 607 medium and 77 heavy trucks, and 289 trailers.

Since the start of the program on March 9, 1942, a total of 182,755 vehicles of all types has been released.



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This will be the THIRD EDITION of the WAR-OIL DIRECTORY—corrected to December 1st. It will contain the names, titles, addresses and telephone numbers of all the individuals, agencies, and their committees, both government and industry, active in the war-oil program. See left hand column for table of contents.

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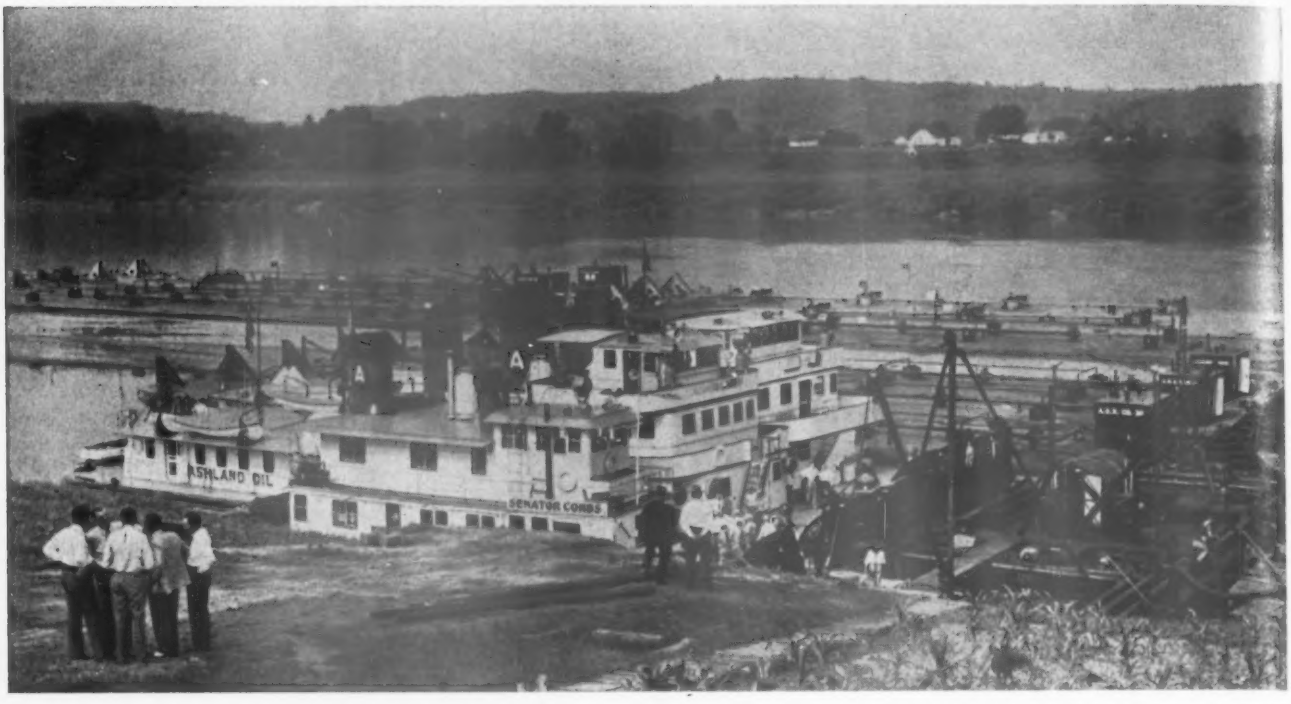

Busy scene at Ashland Oil & Refining Co.'s river terminal at Catlettsburg, Ky., as three towboats and their tows of barges are being unloaded. Crude brought by river barge to the Catlettsburg terminal is piped underground to company's refinery

Bigger, More Efficient River Oil Terminals Sighted Postwar

Barge Transportation of Petroleum, Yet in Its Infancy, Holds Promise of Being Large Factor After the War. Terminals Can Stand Improvement, Efficiency-Wise

By J. Mack Gamble

THERE ARE ALMOST as many different kinds of oil terminals along the inland rivers as there are terminals. This is not surprising for river transportation of petroleum products was just in the formative stage when World War II greatly accelerated its development. Time would not permit more gradual experimental work. The one object was to get oil and gasoline moved to where it was most needed by the best means available. There is no doubt that many of the oil terminals are lacking in various needed features, but they all possess one extremely worthwhile feature—immediate utility and ability to play their part in winning the war.

When the writer asked M. C. Dupree, transportation manager of the Ashland Oil & Refining Co., a firm which is playing a big part in river transportation, as to his views on the oil terminal of the future, he replied, "I believe that you would be safe in stating that they will be larger and probably considerably more of them."

Ashland's own experience on the river are illuminating in making clear what has been happening to river oil terminals in the last 12 years. In 1931 that company had one 30,000-gal. barge terminal, while its floating equipment consisted of one small sternwheel towboat and two small barges, with a total carrying capacity of 125,000 gal. In 1943 the company's fleet had a carrying capacity 100 times as great and its terminals included one at Covington, Ky., and one at Floreffe, Pa. each provided with several million gals. of storage, large unloading lines, adequate tank car facilities, and truck loading facilities which permit the loading of transports of 4000 gal. capacity in not more than 15 minutes each.

Some Simple, Some Elaborate

Terminals in use along the rivers today may be said to range from the ridiculous to the sublime, inasmuch as one may consist of a pipeline extending to the water's edge, and nothing more, while at the other extreme would be something like the Standard Oil Co. of Louisiana's huge docks at Baton Rouge. A number of oil companies made their beginnings on the river in quite a small way to determine just what were the benefits of river transportation. In using small boats and barges it likewise was possible greatly to simplify terminal requirements. The small boats could approach the shore at most places without the necessity of a dredged harbor. And they could be moored reasonably well without elaborate fastenings.

The Standard Oil Co. of Ohio, for instance, began river operations with a small sternwheel towboat of 120 h.p. and some small barges. This fleet was intended to make deliveries to various bulk stations located at small towns along the upper Ohio River. Needed facilities at these landings consisted of little more than pipelines reaching to the normal pool stage of the river. Hose connections were then made from barge to the pipeline and the gasoline or other petroleum product was pumped through the lines to storage tanks.

Provision for fluctuation in the river stage was made by providing connections for the hose at various places on the pipe line as it ascended the river bank. This arrangement was quite satisfactory for the purpose intended and is still in vogue for the smaller craft.

However, a different terminal design is necessary to cope with huge barges 200 ft. in length, drawing eight or nine feet of water and pushed by such powerful craft as the 2415 h.p. "Sohioan", now the flagship of the Standard Oil of Ohio river fleet.

Still in Formative Stage

The development of river terminals is in a formative stage and one of the odd things that may still be seen along the inland waters is a $750,000 fleet with 3,000,000 gal. of oil products hauling up to a mud shore, as primitive as when the Indians left it, to deliver cargo.

One steamboat pilot says, "Some terminals represent investments of many hundreds of thousands of dollars; others are a mere opening in the willows and hard to locate. I have taken loaded oil barges into landings of the latter type and, after the muskrats have swum away and the willows have stopped whipping back and snapping off, you see the hose

—an oil man is always looking for a hose—basking in the river mud with one end disappearing in thick vegetation and the other end gaping riverward. This goes by the name of terminal just as surely as does the new and up-to-date dock of the Sinclair Refining Co. at Cables Eddy near Steubenville, Ohio."

This new Sinclair river terminal has attracted a good deal of attention and is already playing a major part in relieving the gasoline shortage in the East. The pipeline to which it connects was originally intended to be a westbound line from Marcus Hook, Pa., to Steubenville, Ohio, with a branch from Schaefferstown, Pa., to Baltimore and Washington. In view of war conditions and East Coast scarcities, the flow of the line was reversed from Steubenville to Schaefferstown, and the terminal at Steubenville is used as a loading point for eastbound shipment. The terminal has 320,000 bbls. of steel tankage, while barge unloading facilities are capable of handling from 1500 to 2000 bbls. an hour. The capacity of the pipeline is 12,000 b/d, and the terminal site occupies 50 acres. Barges reach this terminal from destinations as far away as Texas, and also from a pipeline terminal at Helena, Ark., and arrive in tows totaling 30,000 to 90,000 bbls.

Part of Bigger Project

The Steubenville terminal is part of a more extensive project Sinclair has undertaken which includes a pipeline now under construction from Chicago to Toledo, Ohio, which will carry 30,000 b/d of gasoline and light heating oils. This line extends for 220 miles to the western end of Lake Erie whence it is planned to ship the products to Buffalo and other eastern points via tankers and barges, cutting 700 miles from the present tanker route around the Michigan peninsula. Projected is another pipeline to connect the Toledo lake terminal with the Steubenville river terminal, and right-of-way is being taken between Toledo and Columbus and between Columbus and Steubenville. But Daniel T. Pierce of Sinclair says, "No prophecies can be made as to when the line between Toledo and Steubenville will be constructed owing to the uncertainty of obtaining materials."

Texaco Terminal Acclaimed

One of the newer river terminals that has won considerable acclaim from rivermen is Texaco's at Mount Vernon, Ind., which has become an important river port for loading oil and gasoline. This terminal has a landing barge equipped with stationary spars, the latter being provided with hooks for carrying the hoses so that barges may be loaded at widely varying stages of water. It is still possible to load when the river gauge at Evansville shows 38 ft., equivalent to approximately 15 ft., more at Mount Vernon.

This terminal is located on the Ohio River noted for the extreme variability of water stages. However at Wood River, Ill., around on the Mississippi, another important terminal point, provision must also be made for some fluctuation in the water level. Here, where Shell, Standard and others have docks, one also uses a landing barge which automatically adjusts itself to the river stage just as did the old time packet wharfboat. A wooden landing barge is claimed to have some advantages at an oil terminal due to eliminating the possibility of striking sparks from a steel deck.

The largest river terminal of the Standard Oil Co. of Louisiana is known as "Riverside" and is located at Memphis. It has a gross capacity of 351,000 bbls. and the storage tanks range in size from 10,000 to 60,000 bbls., being arranged to handle a wide variety of products. There are two docks at this terminal, one intended for loading and unloading barges and the other for supplying fuel to river vessels. Both docks are constructed of wood piling and floored with heavy decking planks. The docks are built high enough so that barges can be loaded or unloaded during normal high river stages.

Other Big Terminals

Unloading of barges is accomplished at the rate of approximately 3000 bbls. per hour using pumps installed on the barges—and transferring of several grades simultaneously from a large tow accounts for the high unloading rate. Loading from terminal to barge is accomplished at a lower rate, chiefly by gravity. Loading and unloading hose suspended from the dock and raised and lowered by mechanical hoists permits quick mooring and disconnecting at any normal river stage. The mooring facilities at "Riverside" consist of wood pile clusters or "dolphins", located and spaced so as to permit mooring of tows of various dimensions.

The next largest terminal of Standard of Louisiana is located at Chalmette, La., about five miles below Canal Street, New Orleans, and it is similar to the Memphis terminal except that storage capacity is approximately 200,000 bbls. and the tanks range from 2500 to 25,000 bbls. in size. A bunkering dock at Chalmette is fitted to supply ocean-going, harbor and river vessels. A bulk terminal of 150,000 bbls. capacity is located at Grand Lake, Ark., situated in an old section of the Mississippi River near the lower end of the Worthing Cut-Off.

This terminal was formerly used for storage of crude oil to be shipped subsequently to Baton Rouge. Since the portion of river on which it is located has been abandoned, further improvements here are unlikely although occasional shipments of clean products are still made to Grand Lake.

At Nashville, Tenn., 185 miles above the mouth of the Cumberland River, is an unloading terminal of Standard Oil of Louisiana, which is used chiefly for unloading barges brought up the Mississippi, Ohio and Cumberland rivers from Memphis. The capacity here is 118,000 bbls. and a landing barge is used for making the hose connections. Barges can be unloaded at the Nashville terminal at a rate of approximately 1000 bbls. per hour.

The Koppers Company recently made improvements to its dock at Follansbee, W. Va., which make it very much of the type at which rivermen are pleased to make landings. Extensive use of wooden piling was made here so as to provide adequate space for placing barges without risk of grounding them, and good mooring facilities have been included. Another plan used by Standard Oil Co. of New Jersey at its Midland, Pa., landing as well as at various other Standard landings along the river is the use of clusters of steel piling which likewise afford good landing places.

The problem of design and operation

A tow of barges from the South arrives at Sinclair's new river terminal at Cables Eddy on the Ohio River. Rivermen like piling clusters like those shown at right in the picture for mooring barges

Pump float at Ashland Oil & Refining Co.'s Floreffe (Pa.) terminal

of a river oil terminal are many. Its primary function is to serve as a coupling between shore tanks and liquid cargo barges for the purpose of either loading or unloading the latter, or both. Facilities may be provided to handle several different types of product (even the simplest landing usually has two lines). Often several barges must have cargo transferred simultaneously. It can scarce be said too often, when speaking of the Ohio, Mississippi and tributary rivers, that the terminals must be designed to operate efficiently in spite of extreme changes in the river stage, otherwise it will frequently be inoperative, perhaps when most needed.

The dredged harbor (if any) must be large enough and deep enough to allow for the moving of barges so that they may be loaded to a draught of 8 or even 10 ft. without grounding. Arrangement must be such that the hose lines will be reasonably short. If the terminal is located on a slackwatered river such as the Ohio, conditions may be expected to be favorable during the seasons of the year when the river is in "pool stage" but consideration must also be given as to how favorable the location is for functioning in periods of open river and swift current. In general, locations of extreme current are undesirable.

Landings Often Difficult

The barge equipment used for moving oil and gasoline on the river is quite diversified—most terminals will have to cope with barges of varying size and equipment. From the terminal standpoint, perhaps of greatest interest is the pumps with which the barges may or may not be provided. Some barges have motor pumps, using gasoline or oil for fuel; others have steam pumps; and still others have no pumps. Needless to say the condition and capacity of the pumps are of prime importance.

The problems of rivermen who have to "land" large tows at river terminals are often of grave proportions, too. Quite frequently there is little or nothing to land against, and delays and damage may be the result. Large barges must be "spotted" in particular places. They may have to be turned around to get the end upstream which will enable the terminal crew to make the necessary connections. Frequently the arrangement of the barges must be shifted while the transfer of the cargo is in progress. Should the river be falling rapidly when barges are being loaded, it is no easy matter for the towboat to keep the barges free from grounding. All this makes up a large order of grief for the towboat crew who may have been out on a long trip and are eager for some "free" time ashore while their boat is in port.

Pilot Tells of Troubles

One steamboat pilot described his first experiences in piloting an oil tow by telling how he blew the landing whistle for the oil terminal destination after a 16-day trip, meanwhile thumbing a railroad timetable to determine how he could best get home for a brief visit while the towboat was at the bank. But no sooner did the tow touch the dock than a terminal manager jumped aboard and proceeded to the pilothouse where he instructed the pilot as follows: "That outside barge on the head of your fleet, number 641, goes on the inside, turned around, with the hose connection spotted at the lower coupling. Then, number 811 will go on the outside up on the head, shoved up halfway on number 818 so that we can get those 4-inchers hooked up across for the fuel oil which will have to be pumped through the lines on 41 because the pump on 665 is out of order, and that will spot 522 down here at this end on the outside so we can unload half of it across 641 and then turn it around and get the other half through the 6-incher."

All this caused the pilot to let go his hold on the railroad timetable and murmur weakly, "What for?" Whereupon he was rewarded with: "Well, you can't pump with the pump on 641 when the aft end is unloaded first because it won't clean up, so that's why you have to—"

"Never mind," said the pilot. "Just tell me what you want done first. I have made a mistake. I brought this tow in here thinking we had come 2000 miles to deliver it to you. Now it seems we must tear it apart, turn it all around, play tag with a lot of hose lines and try to humor some pumps that only seem to work when they feel like it. It's my mistake. I thought I was a pilot. I'm a hostler on a switch engine."

Two hours later the barges were spotted. In another hour the hose lines were coupled and the pumping commenced. Our pilot friend began to think of catching the last train for home which left in 20 minutes. But along comes the terminal man with, "We'll be ready to turn 641 around in about two hours from now."

Delays Are Often Costly

All of which poses the problem as to what are the responsibilities and duties of towboat and crew at a river terminal and what are the specific duties of the terminal crew. At what point, if any, does the responsibility of the towboat crew pass to that of the terminal? Must this responsibility be divided, and if so, throughout the entire cargo transfer or only part of it?

The entire problem is complicated by the fact that the river transportation of oil and gasoline must still be considered to be in its infancy—though it is a lusty and fast-growing infant—and one is reminded of the early railroading days when tracks were laid in different gauges and there were no standard car couplings. Likewise some of the early steamboat laws enacted by the various states bordering the streams each with its own requirements—and thus ultimate confusion.

Delays at terminals on rivers of the Mississippi system occur daily, hourly. These delays are shockingly expensive inasmuch as perhaps $750,000 worth of equipment may be tied up pending the whims of some old pump with a leaky heart, or while a terminal and barge crew wrack their collective brains trying to unsnarl the ever-present problem of how to connect hose lines through an intricate maze of piping and tubing. And while all this is going on the river may be falling six inches an hour, adding the worry of stranding.

No Two Are Alike

Terminals along the rivers are like thumb prints; no two alike. Many factors of a variable nature dictate local requirements. The terminal may be on a bluff river bank, or it may appear on a long, sloping grade. It may border deep water in a protected place, or it may be along a rocky shore where the current is as swift as a mill race.

Generally speaking, terminals are designed for one of two purposes: to load oil products, or to unload them. At a

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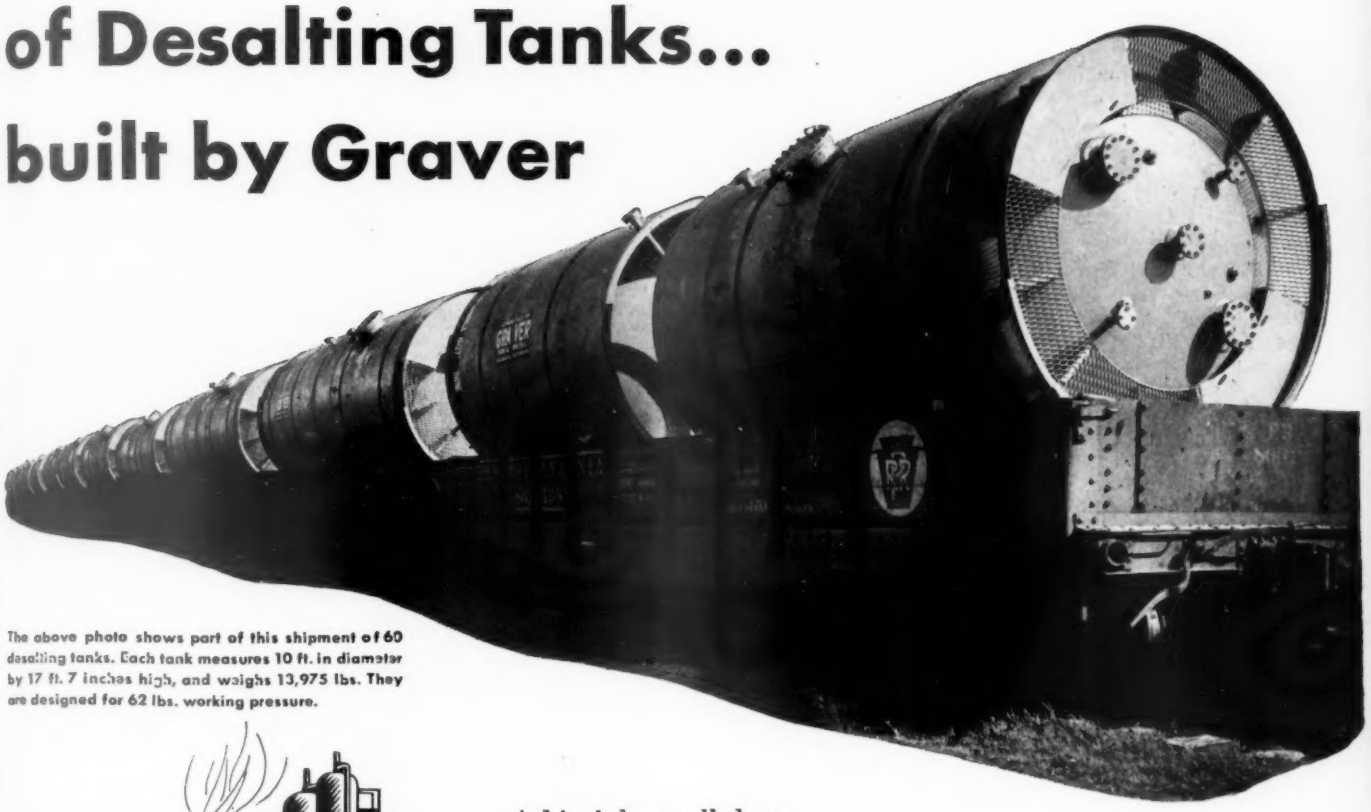

The above photo shows part of this shipment of 60 desalting tanks. Each tank measures 10 ft. in diameter by 17 ft. 7 inches high, and weighs 13,975 lbs. They are designed for 62 lbs. working pressure.

A big job—well done.

60 desalting tanks—30 carloads of them—on their way to speed up the production of petroleum products.

They're Graver-built—which means that they measure up to the most rigid specifications and will meet every requirement as to quality, performance, and cost.

Fabricating steel plate equipment for the Petroleum Industry is one of our most important activities. We have the equipment, the experience, and the trained personnel to handle any job, large or small. Your inquiry incurs no obligation.

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Expansion Roof Tanks **Towers** **Pressure Vessels**

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Refining Equipment

43-20-S

loading terminal the problem of the flow of the product through the hose lines is not a hard one at most inland river points. Usually the tanks are high above the barges and gravity takes care of the situation. But even these terminals are not immune to delays. The nature of delays at such landings is twofold: (1) danger of stranding the barges while loading is in progress, and necessary halts to "spar out" as the loading progresses, and (2) the problem of gathering up the barges and hitching them in a unit for towing after the loading is completed.

When loading a tow it is usually to be expected that the inside barges will strand first, being next to shore, and if the fleet being loaded is coupled up two or three barges wide—as is often the case—the task of "unsticking" a barge necessitates disconnecting all hose lines and moving the entire fleet of barges, sometimes one at a time, in order to get at the source of the trouble. Such a condition may require as much as three hours to remedy. Similarly a terminal located in a poor place with reference to the navigable river channel may require the towboat crew to pick out the loaded barges one at a time, or two at a time, and take them elsewhere to hitch into a fleet for towing. It is not uncommon to encounter a lapse of from four to six hours from the time barges are loaded until the towboat crew has them made into a fleet and starts on its way to the desired destination. Conditions such as this are fairly common on the western rivers. Oil company officials probably were not acutely conscious of these delays until war conditions placed river equipment at a premium. The cure to these ills would seem to lie along several lines, all connected with the planning and construction of terminals.

Ideal locations for river terminals are not too plentiful and, when found, may be remote from spots convenient for the oil trade. An ideal loading terminal for an Ohio or Mississippi location seems to be one provided with substantial piling of some sort. This piling holds the barges out in deep water and prevents or minimizes the danger of grounding. It also helps the towboat crew "make up" the fleet after loading is complete. The scheme for running hose connections to such piling should be devised to cope with river conditions so that even with fluctuations of as much as 20 to 30 ft. in water stages there is no hitch in making convenient connection between barges and shore pipelines.

The provision of adequate fastenings for mooring ropes is important and in the past has been too often overlooked. Apparently trivial details are often responsible for great losses of time. Boatmen are familiar with delays of hours in "hooking" mooring lines which have been allowed to drop in the river at oil terminals.

Perhaps an improvement in the efficiency of river oil towing would result from greater standardization.

Oil Shipments to East Show Big Increase; Stocks Still Abnormal

NPN News Bureau

WASHINGTON — Although oil shipments to the East are running more than 500,000 b/d ahead of a year ago, stocks, particularly of gasoline, are still far below normal, PAW Ickes said Nov. 26.

Shipments by pipeline, tank car, tankers and barges totaled 1,704,231 b/d during the week ended Nov. 20 compared with 1,140,327 a year ago, with a large contribution being made by the Big Inch. Mr. Ickes reported that although rated capacity is only 300,000 b/d, the line pumped 301,518 b/d in one day; he expressed opinion that it will maintain capacity operation now that all pumping stations are in use.

Product stocks along the East Coast were listed as follows: (Figures for week ended Nov. 20).

Gasoline, up to 39.5% of normal compared with 36.6 the previous week; heating oil up to 64.2 from 59.7; kerosine, off to 52.3 from 52.9; and residual up to 78.3 from 76.3.

Refinery Runs Fall Off

PAW Ickes attributed tight gasoline and kerosine situation to fact that refinery runs in Southwest and Middle West "have not been up to expectations. We are working with the industry to get these runs increased within the limitations of available crews."

Analyzing transportation situation, Deputy PAW Davies pointed out that pipeline shipments during the week exceeded by 303,950 b/d those during the same period a year ago.

"Movement of oil by water transportation during the period covered in the current bulletin," he said, "was abnormally high, due to the availability of extra tanker space during that particular week. This figure will vary from week to week, depending upon how many tankers are made available for East Coast service."

Mr. Davies said tank car shipments will probably remain under the 800,000 b/d mark from now on. He said 11,000 tank cars, formerly used in short haul service from Norris City to eastern destinations, have been placed on other essential runs.

Lag in Transport Cuts Texas December Oil

Special to NPN

AUSTIN, Tex.—A transportation bottleneck will cut down the Texas December oil production slightly below that of the current month, according to the statewide oil order issued by the Texas Railroad Commission.

The December basic allowable will be 2,009,509 b/d, compared to 2,061,893 for November.

The difficulty of getting West Texas crude to market has not been met, the pipeline network soon to serve that section being still unfinished. In addition, the commission advised that a tank car bottleneck had developed, which forced Standard of New Jersey to cancel orders for 8000 b/d from Tom O'Connor field and 9000 b/d from the Hawkins field. Coastal fields could not move their allowables and were cut back more than 4000 barrels daily.

The Panhandle area was the only sector raised. Production there was raised from 93,819 to 107,537 by increasing production days from 22 to 27.

Railroads' Fuel Demand Set

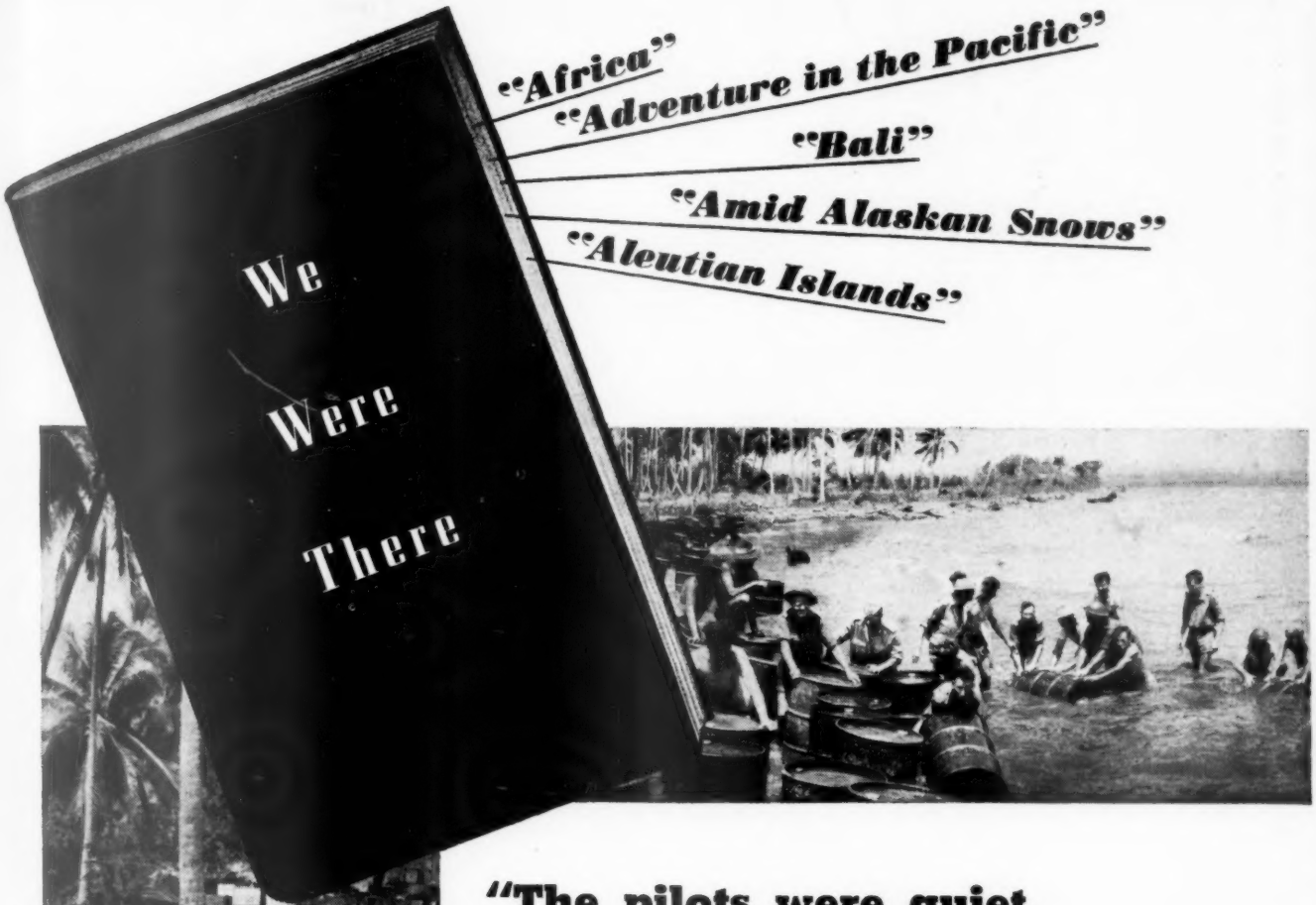
Special to NPN

ST. LOUIS—Southwestern railroads' demand for heavy fuel oil for December has been set at 1,500,000 bbls. according to figures arrived at Nov. 22-23 by District 2 and 3 directors of supply, staffs of supply and distribution committees and railroad fuel oil buyers. In order to meet demand, some 500,000 bbls. will have to be moved from District 3 into District 2 and 100,000 bbls. will have to be taken from storage. The group will meet again at the Mayfair Hotel here, Dec. 20.

Rail Hauls To East Up 5252 b/d

WASHINGTON—Tank car shipments to District 1 averaged 763,383 b/d during the week ended Nov. 20, up 5252 b/d from the previous week. Shipments by 52 companies follow:

Allied	53	Gulf	2338	Shotmeyer	10
American Bitumuls	72	Hartol	167	Sinclair	1106
Amsco	394	Home Oil	22	Socony-Vacuum	2806
Arkansas Fuel Oil	4	Jenney Mfg. Co.	100	Southland	12
Ashland Refining	78	Libby	2	Southport	70
Asiatic Petroleum	78	Old Dutch	fl	S. O. California	6
Atlantic Refining	1367	Pacific	40	S. O. Kentucky	38
Bell Oil & Gas	1	Pan American	1417	S. O. Indiana	74
James B. Berry Sons	17	Petroleum Corp.	2	S. O. New Jersey	5717
Cantelou	15	Petroleum Heat & Power	92	S. O. Ohio	99
Chalmette	18	Phillips	215	Sun	2196
Cities Service	923	Primrose	6	Talco	5
Continental	266	Pure	49	Texaco	2417
Crown Central	100	Republic	130	Tide Water	929
Daugherty	21	Richfield	67	Tiona	2
Deblois	10	Royal Petroleum	152	Triangle	50
Elk Refining	16	Shell	894	White	107
Freedom Oil	2				



"The pilots were quiet and solemn that night"...

Many tales have been told of men and tanks and planes. There is a story, too, of the drums of oil and gasoline that have gone with them to distant lands, and have played a part in strange adventures.

That story is told in "We Were There" — a modern odyssey that carries the reader through history-making exploits in Africa, the Pacific, Tunis, the Aleutians, Java and Alaska. It is profusely illustrated with original portraits of Winston Churchill, General Chiang Kai-shek, General Carl Spaatz, General Sir B. L. Montgomery, Lt. Col. Jimmy Devereux, and pencil studies of natives of Tunisia, the Aleutians and Java. A copy of the De Luxe Edition, beautifully bound, will be sent free upon request. Just mail the coupon.

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Briefs from Week's News—

Florida Discovery Reward Claimed By Humble

Special to NPN

HOUSTON—Humble Oil & Refining Co. has claimed the reward of $50,000 and oil leases on 40,000 acres of land posted by the state of Florida for the first discovery of oil in commercial quantities in the state. The oil company has offered to split the reward money between the University of Florida and Florida State College for Women, to be used for scholarship funds.

However, the offer to the colleges is predicated on further tests to determine whether oil in commercial quantities as prescribed by the law is present in the No. 1 Gulf Coast Realties discovery well. In the meantime the company has staked the location for a second test in the center of the southwest quarter of the southwest quarter of section 30-48S-30E.

Survey Drilling Equipment

Special to NPN

DALLAS — American Assn. of Oilwell Drilling Contractors has sent each of its members a drilling equipment survey questionnaire, to be filled out and forwarded to Glen Campbell, chief of PAW's priority section. Purpose of the questionnaire is to determine the particular equipment shortages which are slowing down drilling operations.

A. H. Rowan, president of the association, in the letter which accompanied the questionnaires, told members that with direct information at his command, Mr. Campbell can inform WPB of the industry's equipment needs. Information, according to Mr. Rowan, is particularly needed on the situation as regards the shortage of tool joints.

Set Louisiana Allowable

Special to NPN

BATON ROUGE—December allowable for Louisiana has been set at 363,942 b/d by the State Department of Conservation. This is 3761 b/d over November and 11,758 b/d under PAW certification. The allowable is split between north and south Louisiana in the amounts of 76,507 b/d and 287,435 b/d.

PAW Ready to Round Up Drilling Workers For 1944 Program of 24,000 New Wells

NPN Staff Special

WASHINGTON—PAW's labor counselors have quietly moved in on another urgent manpower problem in the oil industry and with the help of the War Manpower Commission have set up a plan for recruitment of thousands of oil well drilling workers so that PAW's 1944 program of 24,000 new wells will have a greater chance of success.

It is estimated that under the expanded program, an additional 8000 workers will be needed during the next few months by the drilling contractors in the Mid-Continent areas.

Until the last year or so, the drilling branch of the industry was practically self-sustaining so far as manpower requirements were concerned. A pool of workers had been developed which was available wherever field operations were carried on and their identity and qualifications were well established. In the past year, however, about 15,000 drilling workers have entered other industries because of slackness in drilling operations, resulting in irregular employment and rapid expansion of war industries.

This is the second in a series of manpower problems affecting the petroleum industry—*Ed.*

The only practical solution was negotiation for transfer of former oil well employes from shipyards, aircraft factories, and other war industries.

Addresses To Be Listed

Oil well drilling contractors have the names and addresses of many of these experienced oil field workers and, according to the plan worked out, will furnish this information to WMC. The manpower agency, has agreed to negotiate transfers as quickly as replacements are available to fill the positions that would be left vacant, provided drilling contractors assure full-time employment for the transferred workers. In view of PAW's 24,000-well program for 1944, there is little doubt of full-time employment.

Under the policy and procedure worked out by PAW, WMC and the American Assn. of Oil Well Drilling Contractors, the association will maintain a central recruiting office in Dallas, Tex., which will be under the direction and supervision of one person on a full-time basis, to act as the intermediary between the drilling contractors and WMC.

For its part, WMC will maintain a petroleum industries unit within the placement division of its regional office at Dallas, also with an employe on a full-time basis.

Briefly, here is what the drillers' central recruiting office will do:

1. Secure the approximate number of additional skilled workmen required by the association and other drilling contractors to carry out PAW's increased program.

2. Prepare and submit to WMC's petroleum industries unit a schedule which will summarize the combined labor demands of all associated contractors and indicate area in which demand occurs and numbers needed by occupations, and dates.

Census of Well Drillers

3. Determine the number of drillers and other employes with three years or more experience who are now employed in other industries and whose present whereabouts are known, and furnish WMC the following information: (a) Name of worker; (b) social security number; (c) present residence address; (d) present employer and address; (e) present occupation; (f) name of drilling contractor who will employ the worker; (g) occupation in which the worker will be employed.

4. Provide for the full utilization of each worker to the maximum extent of his skill by arranging transfers of skilled workers between contractors as certain phases of any individual operator's drilling operations diminish or increase.

5. Set up and maintain the necessary machinery to handle intra-industry transfers to provide for continuity of work and retention of oil workers in the industry who become employed in any particular locality.

6. Insure compliance with various WMC area stabilization plans by referring every case in which a worker is recruited or is to be transferred from one WMC area for work in another to the WMC Dallas office for clearance with the appropriate WMC organization unit.

What WMC Undertakes

As for WMC's petroleum industries unit, it will:

1. Transmit to the WMC state director in Region X, or the appropriate WMC regional director of other regions, a list of names of former employes containing the information furnished by the central recruiting office who are currently employed in other industries for distribution to the appropriate states or areas.

2. Attempt to recruit through U. S. Employment Service, either by negotiation with present employers of pre-designated skilled workers or through normal recruitment, the required number of workers. If recruitment is by negotiation and the workers are engaged in an essential industry, the unit will follow this procedure:

A. Contact the present employers of listed individuals and explain fully to them the intent and purposes of the program.

B. Determine whether or not the

No.4 IN A SERIES OF ADVERTISEMENTS TO PROMOTE CONSERVATION OF THE TIRES ON AMERICA'S CARS SPONSORED BY PETROLEUM INDUSTRY WAR COUNCIL

"— NOW MORE IMPORTANT THAN EVER THAT...YOUR CUSTOMERS' TIRES GET THE BEST OF CARE!"

RUBBER DIRECTOR

WAR PRODUCTION BOARD
WASHINGTON, D. C.

OFFICE OF
RUBBER DIRECTOR
Tel. Republic 7500

September 23, 1943

IN REPLY REFER TO:

TO ALL GASOLINE AND TIRE DEALERS:

Because you, as service station operators, are in a position to be the most effective agents, you were urged by your government to help conserve America's largest stockpile of rubber - the tires now on America's cars.

Paced by the nation-wide campaign sponsored by the Petroleum Industry War Council, you have rallied to the emergency and are doing a fine job. But, don't let down now! For although fortunately we are now assured of an adequate supply of synthetic rubber, the job of supplying tires is still far from complete.

None but the most essential drivers can expect new tires at least until the middle of next year. This means that it is now more important than ever that you participate 100 per cent in America's tire conservation program by seeing to it that your customers' tires get the best of care, and are recapped when necessary. For once a motorists' tires become worn beyond the recapping point, in most cases, they can't be replaced; and you've lost a customer.

Tire conservation is a matter of good sound business as far as you are concerned, as well as your patriotic duty. Again we urge you and every gasoline and tire dealer to "Save the Carcass" of America's tires.

Very truly yours,

Bradley Dewey
Rubber Director

THE Rubber Director is talking to YOU . . . when he says, in effect, "It's not yet over, over there." Talking to YOU who have done such a magnificent job so far. YOU who *must not* let down now!

Why is this message so all-important to YOUR business? Simply because, if you once allow a customer's tires to wear beyond the recapping stage—it means the end of both tires and customers.

This need not happen. Give the tires on every car you service the best of care, and when necessary, see to it that they are recapped!

Petroleum Industry War Council

(CREATED BY THE PETROLEUM ADMINISTRATOR FOR WAR)

Committee on Product Conservation

present employer will release the worker as soon as a replacement can be made available.

C. Contact the worker after permission to do so is granted by the present employer and find out if the worker will accept transfer.

D. Arrange for replacement according to established procedure, if the worker agrees to transfer.

E. If the employer refuses to release the worker or grant permission to contact the worker, and it can be determined that the worker is being offered a position which will utilize his skill to a higher degree than that currently occupied, the procedure covering the "referral of workers in case of under-utilization," as provided for in WMC regulations, will be followed, as will the applicable stabilization plan and the employer will be so informed.

F. Advise the central recruiting office, and the state regional WMC offices, of the release date agreed upon for transfer of the worker.

G. Deliver a letter to the applicant which will offer employment and contain the terms of employment, together with transportation instructions.

H. Issue a referral card to the applicant directing him to the contractor who has agreed to employ him and for whom he has agreed to work.

As regards the manpower pinch in other phases of oil production, PIWC Chairman Boyd last week estimated that about 85% of the men between 18 and 35 will be lost within the next year and urged neighboring operators in production activities to pool their personnel.

He pointed out that a serious shortage of pumpers and other oil field workers already exists and that many of these jobs cannot be classified as critical or essential under present rules and so the production branch of the industry must expect to suffer a severe loss of manpower.

Of the 200,000 men employed in oil production, Mr. Boyd estimated there were 10,000 in exploration other than drilling; 30,000 in drilling, and 160,000 in operation of the wells. About 35,000 new employes will have to be recruited in 1944, he said, of which 15,000 will replace prospective losses in Selective Service and other industries; while an additional 2000 will be needed for exploration; 13,000 for drilling and 5,000 for miscellaneous oil field activities.

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Urges Drilling Contractors To Back Manpower Hunt

Special to NPN

DALLAS, Tex.—Drilling contractors have been urgently requested to fill out and return the manpower questionnaire sent out Oct. 28 (*see NPN Nov. 3, p. 36*) by Brad Mills, executive secretary, American Assn. of Oilwell Drilling Contractors.

The questionnaire pertained to help of WMC in securing return of former employes to the drilling industry.

Ranney 'Wagon Wheel' Oil Well Is Shot In With 6-Ton Charge Over Half Mile Long

Special to NPN

OIL CITY, Pa.—Sixteen months after operations started, the Ranney "wagon wheel oil well" project of the Venango Development Corp., in the Upper Two Mile Run district about two miles north of Franklin, Pa., was shot in on Thanksgiving Day. The 12,000-lb. charge distributed in the project's two wells for a combined distance of 3800 ft. was the longest ever fired in an oil well and this is made more significant by the fact that it was fired in one sand, the Venango First, in two revolutionary horizontal wells drilled from an underground working chamber. (*See NPN, July 7, 1943, p. 35*).

The project, developed by Leo Ranney, may, its sponsors hope, solve the problem of recovery from a field where gas pressure has long been missing. Certainly the application of the theory of horizontal drilling and draining of oil by gravity flow is being made in one of the toughest sands of the Pennsylvania field, a sand that is filled with quartzite which ruins diamond drills and produces a slow-running oil.

Following the shooting, a blockage developed in one of the horizontal wells, and work of cleaning out the hole was started Nov. 30.

While neither the sponsors nor Mr. Ranney would give out any figures on production from the project either before or following the shooting, they appear very well pleased with results and optimism was increasing as work progressed. One report had it that the project was producing 30 bbls. a day, but indications were the flow was greater.

There was nothing to resemble the shooting of a vertical-type well, either from the standpoint of loading or the results after the explosives had been touched off. On the surface there were no visible signs of oil when the shot was fired, only fumes from the dynamite charge drifting up the 8-ft. concrete shaft from the 429-ft. level where the horizontal well had been drilled.

The two horizontal wells had been drilled for a distance of approximately 2350 ft. from the working chamber, or a combined distance of 4700 ft. The wells were filled to within 400 ft. of the working chamber with charges of 80% high velocity gelatine with a quarter-inch line of TNT running the full length of the charge. The gelatine was contained in aluminum shells 8 ft. in length, the shells being prepared especially for the well by Du Pont. The placing of these shells and the TNT was not the only problem involved. Because it was something new in the business of shooting oil wells, even the technicians were not prepared to make any predictions as to what would take place when the shot went off, so every precaution was taken to avoid fire. To overcome this possibility, 600 lbs. of dry ice were placed in the working chamber and allowed to melt into its original state of carbon dioxide, thus creating a 25% mixture in the working chamber to prevent combustion.

Blast Felt on Surface

When the charge had been placed and the electric lights illuminating the shaft removed, a 220-volt charge of electricity was sent over the firing line and was immediately followed by a dull blast and distinct jolt, but little more. Men employed at the project were sent out toward the end of the two wells to determine if both sides of the horizontal well were shot at the same time, and they reported that the jar of the exploding gelatine was felt on the ground where they were stationed.

As soon as the dynamite fumes started drifting from the main shaft, the blowers were turned on and the little valley at the head of which the well is located, was soon filled with the blue-gray smoke. Few spectators remained to breathe this headache producer. However, Mr. Ranney and his crew stayed and an hour after the shot was fired, lowered the working cage to the bottom of its tracks and brought it back to the surface with the bottom wet. It was estimated that approximately 1000 bbls. of fluid was in the working chamber at the time, but the oil percentage was not known.

District Court Upholds Etex Water-Oil Ratio

Special to NPN

AUSTIN—"We have found the proper technical and sound legal way to maintain reservoir pressure: In water drive fields it is by prescribing a proper water-oil ratio; in gas drive fields by prescribing a proper gas-oil ratio."

This was the comment of Texas Railroad Commissioner Thompson on the decision of the 126th District Court, Travis County, Tex., upholding the commission's East Texas 5-to-1 water-oil ratio. The court dismissed with prejudice at plaintiff's cost the suit brought by Roosth & Genecov Production Co. et al against the commission. Earlier, the Austin Court of Civil Appeals held the water-oil ratio was a valid operating rule and not in violation of the marginal well law.

Col. Thompson disclosed the plaintiffs had been offered a connection with the salt water injection system in East Texas but had refused. The 5 bbl. water rule permits the production of 1 bbl. of oil to each 5 net bbls. of water. Credit for water reinjected thus is given, and the 5-to-1 ratio applies only to water not returned to the reservoir.

Credit for the fact that since Jan. 1, 1943, a total of 109,248,549 bbls. of oil were produced from the East Texas field with a drop in pressure of only 8.1 lbs. (from 1015.71 lbs. to 1007.61 lbs. on Nov. 1) was given by Col. Thompson to the commission's water-oil ratio rule.

Coming Meetings

DECEMBER

American Society of Mechanical Engineers, annual meeting, Hotel Pennsylvania, New York, N. Y., Mon.-Fri., Nov. 29-Dec. 3.

New Mexico Oil and Gas Assn., annual meeting, Carper Terrace, Artesia, N. M., Wed., Dec. 1.

Oil Industry, Tire, Battery and Accessory Div., annual meeting and post-war planning clinic, Elms Hotel, Excelsior Springs, Mo., Thurs.-Fri., Dec. 2-3.

19th Exposition of Chemical Industries, Madison Square Garden, New York, N. Y., Mon.-Sat., Dec. 6-11.

Nebraska Petroleum Marketers, Inc., annual meeting, Fontenelle Hotel, Omaha, Nebr., Tues.-Thurs., Dec. 7-9.

National Assn. of Manufacturers, annual meeting, Waldorf-Astoria, New York, N. Y., Wed.-Fri., Dec. 8-10.

New Jersey Oil Trades Assn., annual banquet, Robert Treat Hotel, Newark, N. J., Thurs., Dec. 9.

Interstate Oil Compact Commission, quarterly meeting and election of officers, Broadview Hotel, Wichita, Kans., Fri.-Sat., Dec. 10-11.

Mid-Continent Oil and Gas Assn., 26th annual meeting of general board of directors, Tulsa Club Roof, Tulsa, Okla., Mon., Dec. 13.

Detroit Oil Men's Club, annual election of officers, club headquarters, Detroit-Leland Hotel, Detroit, Mich., Tues., Dec. 14.

Wisconsin Petroleum Assn., annual convention, Hotel Schroeder, Milwaukee, Wis., Wed.-Thurs., Dec. 15-16.

Independent Oil Men's Assn. of New England, Fall convention, Copley-Plaza Hotel, Boston, Mass., Thurs., Dec. 16.

Detroit Fuel Oil Distributors' Assn., annual meeting, Detroit Oil Men's Club, Leland Hotel, Detroit, Mich., Tues., Dec. 21.

Geological Society of America, annual business meeting, New York, N. Y., Tues., Dec. 28.

San Joaquin Valley Oil Producers Assn., Hotel El Tejon, Bakersfield, Calif., Wed., Dec. 29.

JANUARY

Society of Automotive Engineers, annual meeting and engineering display, Book-Cadillac Hotel, Detroit, Mich., Mon.-Fri., Jan. 10-14.

North Carolina Oil Jobbers' Assn., annual meeting, Hotel Carolina, Raleigh, N. C., Wed., Jan. 12.

Northwest Petroleum Assn., annual meeting, Nicollet Hotel, Minneapolis, Minn., Thurs.-Fri., Jan. 13-14.

FEBRUARY

American Institute of Mining and Metallurgical Engineers, annual meeting, Waldorf-Astoria, New York, N. Y., Sun.-Thurs., Feb. 20-24.

Iowa Independent Oil Jobbers' Assn., annual meeting, Hotel Fort Des Moines, Des Moines, Ia., Wed.-Thurs., Feb. 23-24.

MARCH

National Farm Chemurgic Council, annual meeting, Statler Hotel, St. Louis, Mo., Tues.-Wed., Mar. 28-29.

N. J. Group Names Slate

Special to NPN

NEWARK, N. J. — The nominating committee of the New Jersey Oil Trade Assn. announces the following nominations for officers and directors for 1944: President, Frank P. Gill, Adam Cook's Sons, Inc.; vice-president, James E. Sheehan, Fiske Bros. Refining Co.; secretary-treasurer, Alfred R. Lange, United Industrial Products, Inc.; national counselor, A. L. Saltzman, Standard Oil Co. of New Jersey.

Nominated for directors' posts are: Frank G. Campbell, Sun Oil Co.; Robert W. Valter, Tide Water Associated Oil Co.; Benjamin C. Price, Swan-Finch Oil Corp.; Roy E. Probert, Standard Oil Co. of New Jersey; Walter W. Krautter, W. W. Krautter, Inc.; Arthur Phillips, Jr., National Oil & Supply Co.; and Frank J. Mahoney, Renick & Mahoney, Inc.

Serving the PETROLEUM INDUSTRY for 40 years

BLACKMER · ROTARY · PUMPS

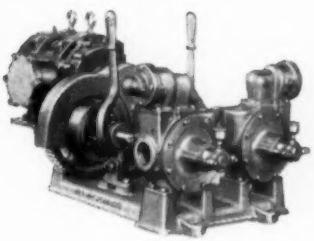
they are Self-Adjusting for Internal Wear!

due to "Bucket Design" (swinging vane principle)

That means normal capacity throughout the life of the buckets - no loss due to wear. 20 years of service is not unusual for a Blackmer pump.

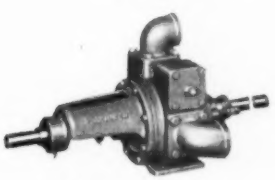
BULK PLANT PUMPS

Capacities 50 to 750 GPM (single pump) Pressures to 300 psi. Single or multiple units. All standard drives. Direct-connected units 5-10-20 GPM. 100 psi.



TRUCK PUMPS

Capacities 20 to 200 GPM. Power take-off or Gasoline Engine drive. Quiet, efficient units that speed up deliveries — increase truck road time.



HAND PUMPS

Capacities 7 to 25 GPM. Made in 54 different models. Standard and heavy duty barrel pumps and complete refueling units.

Ask any pump man about Blackmer Rotaries.

Write for Bulletin No. 304: FACTS ABOUT ROTARY PUMPS, and Bulletins on Truck Pumps and Hand Pumps.

Blackmer Pump Company, 18812 Century Ave., Grand Rapids 9, Mich.

BLACKMER Rotary PUMPS
"BUCKET DESIGN"-SELF-ADJUSTING FOR WEAR

EASTERN IMPORTERS PUSH TEST OF PAO 5

(*Continued from p. 6*)
rective 59 with an order such as PAO 5 entailing criminal penalties. He summed up the E.P.I.C. case in these words:

"'We demand a strict compliance with the order in that only the two grounds be used in the handling of applications, or that the criminal penalty provision be stricken from the order. Otherwise you will push us into the courts."

E.P.I.C. is widening and perfecting its organization in anticipation of the expected legal battle. It is composed chiefly of importers into the district who are not original suppliers, but it is seeking contact with all oil men who have problems under PAO 5. E.P.I.C. is headed by B. M. Solomon of Tankar Stations, Norfolk, Va., as chairman; and J. D. Meyer of Washington as secretary-treasurer. Directors include T. F. McGarey, Dornoil Products Co., Newark, N. J.; S. D. Wilkes, Crown Petroleum Corp., Springfield, Mass.; Albert Shotmeyer, Shotmeyer Bros., Hawthorne, N. J.

★ ★ ★

E.S.P.A. Joins Attack on Operation of PAO 5

NPN News Bureau

NEW YORK — Empire State Petroleum Assn. has launched an attack on PAO 5, claiming that the order "does not in any way promote equal distribution, nor does it improve the cause or reason from which unfair practices and abuses arise."

In an editorial entitled "PAW Invites Attacks on Its Sincerity", in the November issue of ESFA, the association's publication, it is charged that unequal distribution and discrimination have been the cause of much complaint. ESPA quotes PAW's letter of Oct. 1, 1943, stating the agency's aim that "the petroleum industry operate in such a way that all marketers and consumers of petroleum products may secure their proportionate share, without discrimination, of the sum total of whatever petroleum products are made available in District 1."

'Only a Statement'

ESPA says: "For PAW to state that these conditions will be corrected by merely restating its policy, without first attempting to put that policy in force, PAW cannot hope to obtain the co-operation of the industry, and a move of this kind only tends to aggravate the whole problem by inviting attacks on the whole PAW program."

The association charges that PAW's purported purpose of equalization is simply "a statement which has never had any basis in fact but merely serves to becloud the issue. This fact has been proven time and again."

'Sins of a Few . . .'

ESPA attacks PAW's statement that PAO 5 provides that "importers of principal petroleum products will be required to obtain PAW approval for all receipts except those specifically covered in regular monthly schedules prepared under Directive 59". "We hold this paragraph to be self-evident," ESPA says, "of the purpose behind this order, for PAW knows that Directive 59 has never provided, nor can it provide, a proportionate share of product for all without discrimination.

"Does PAW feel that the sins of a few primary and secondary suppliers should be visited upon the entire marketing industry of District 1? Are the sins of these few to be allowed to prevent the honest efforts of many to improve the supply situation in District 1 in an effort to maintain their right of survival?

'PAW Must Keep Faith'

"It has been shown to PAW that much of the product imported outside of Directive 59 would never have found its way into the hands of the original suppliers but for the fact that a great deal of it originated with secondary suppliers outside of District 1, and also to the fact that price would have been a consideration by the original suppliers.

"Attempts of this kind to correct the situation cannot and will not have the complete co-operation of the industry unless PAW faithfully lives up to its obligations to the entire industry and provides equality for all."

Pastor Charges Discrimination By OPA 'Gas' Ration Official

Special to NPN

PONTIAC, Mich.—Alleged discrimination by an OPA rationing board against churches in this area is bringing about circulation of a petition demanding removal of A. J. Diebel, OPA director of Oakland county, Michigan. The Rev. Leland L. Marion, head of the Christian Temple church, one of the largest in this area, charges Mr. Diebel with refusing to renew his "C" book so that he could carry on his activities for the church and states that the petition will be sent to Washington with a demand for action. The congregation of the church staged a two-hour picket against OPA headquarters here Nov. 26 and scheduled a mass meeting for Nov. 30.

According to Dr. Marion's statement, Mr. Diebel cut his gasoline ration 50% last July. Dr. Marion then appealed to the district OPA board which restored the cut. Diebel then told him, Dr. Marion said, "Wait till it comes up next time and I'll show you who is running Oakland County." When he again applied for his "C" book in October the request was ignored. Demanding that Mr. Diebel restore his "C" book, he quoted Mr. Diebel as answering:

"'Your work, Dr. Marion, as pastor of a church, is not fundamental to the war effort. I am not concerned about the churches. I am concerned about getting gasoline for the men who work in shops. In 60 days there will be no gasoline for churches and similar enterprises and the quicker the churches close, the better it will be anyway'".

Dr. Marion declared that he has received a letter from the OPA district director at Detroit asking that he come in as soon as possible to discuss the matter which he will do early this week.

Dr. Marion quoted as one example of discrimination against the churches the case of two war plant workers in this area. Both men, he said, work at the same plant and live only two miles apart and yet one gets 57 gallons of gasoline to the 13 gals. allotted the other who is a deacon in his church.

On the House floor Nov. 30, Rep. Clare Hoffman of Michigan repeated Rev. Marion's charges. OPA gives union officials gasoline while denying it to the church, said Rep. Hoffman.

Eastern Dealers Demand Simpler Ration Rules

NPN News Bureau

NEW YORK—Gasoline dealers' representatives met with OPA officials in Washington Nov. 17 in an effort to convince OPA that present rationing rules are so complicated that almost every dealer, knowingly or not, violates some regulation and makes himself subject to suspension. The dealers' group comprised Harry Wainwright, executive secretary of the Washington and Baltimore Gasoline Dealers Assn.; Frederick Moore, executive secretary of the Massachusetts Retail Gasoline Dealers Assn.; John Donahoe, Pittsburgh; and John Dressler, president of the Eastern States Gasoline Dealers and the New Jersey dealers association. They conferred with R. C. Harrison, OPA gasoline rationing chief; W. R. Koemer, J. F. Matthews and H. Blackshear, all of OPA.

The dealer committee urged that rules be simplified, stressing especially the accountability provision (inventory out of balance), pointing out that this regulation actually creates a black market because if a dealer cannot balance his inventory and his evaporation loss is greater than 1%, he will be suspended, and hence compelled to purchase black market coupons to make up his inventory.

"There are so many ways in which inventory can honestly become unbalanced that it is unfair to use this as evidence for suspension order," the dealers told OPA.

The Week's Orders

(Issued Nov. 20-27, Inclusive)

PAW—Petroleum Administration for War

PDO 3, SO 1, Revoc.—Fuel oil for electric power

PDO 19—Micro-crystalline wax restrictions

OPA—Office of Price Administration

Prices

GMPR, Rev. Sr. 14, Am. 51—Servicing charge for rubber

Rev. SR 15, Order 110—Sinclair barge rental increase denied

MPR 53, Am. 8—Inedible lard and pork fat

RPS 66, Am. 7—Retreading passenger tires with Grade A camelback

RPS 88, Order 13—Liquefied petroleum gas increase

Order 14—Fuel oil increase

MPR 134, Am. 13—Rental construction equipment (repairs)

MPR 170, Order 4—Anti-freeze ceilings

Recent Price Interps.—Proc. Reg. 6—Sales to British customers

MPR 28—Ethyl alcohol

PS 49—Warehouse steel

PS 96—Domestic fuel oil storage tanks

MPR 170—Types N and S anti-freeze sales

MPR 411—Field-assemble reusable storage tanks

Rationing

RO 5C, Am. 84—Gasoline rationing

Am. 85—Transfer of ownership of vehicle

RO 11, Am. 89—Definite value coupons (fuel oil)

WPB—War Production Board

L-63—Suppliers' inventory restrictions

L-199, Interp. 2—Storage water heater tanks

L-221—Electric Motors and generators

M-81—Telegram, WPB Containers Division, motor oil cans

M-195, Revocation—Wax

M-293, Table 9—Indicating and control instruments

CMP 5, Interp 4, Revocation—Outer shipping container materials

Pri. Reg. 1, Interp. 4, as am.—Compulsory orders

Pri. Reg. 1, Interp. 8—Small order exemptions

Pri. Reg. 3, as am.—Application and extension of preference ratings

Pri. Reg. 3, Direction 3—Outer shipping container materials

Pri. Reg. 3, Interp. 7—Use of ratings for processing of material

Pri. Reg. 18, Direction 1—Compressor, pump, etc. order deadlines

DSC—Defense Supplies Corporation

Rev. Reg. 1, Am. 2—Petroleum compensatory adjustments

E. O.—Executive Orders

E. O. 9346, Construction—Discrimination clause mandatory

Digest of Week's War-Oil Orders

Petroleum Administration for War

FUEL OIL FOR ELECTRIC POWER—PDO 3, SO 1, Revoked—Restrictions removed on East Coast use of fuel oil for electric power generation. Issued and effective 11-19.

MICRO-CRYSTALLINE WAX RESTRICTED—PDO 19—Deliveries of micro-crystalline wax (amorphous or petrolatum wax) or any blend of it with paraffin wax may not exceed 3000 pounds per quarter to any one person, and no supplier may deliver more than 2½% of his total production of wax during any quarter without authorization of PAW Marketing Director. Monthly acceptance of deliveries may not exceed 1/3 the quarter's small-order quota except for make-up deliveries of unfilled quota of previous month, or by special permission of Director of Marketing. Larger deliveries may be accepted for sake of filling delivery container or tank car, and such excess is to be deducted from following month's or quarter's quota. Special applications for quantities larger than the small-order allotment must be made on Form WPB PD-2945. But special allotment and small-order allotment may not both be accepted by one person. Suppliers must report by 12th of month preceding each quarter estimates of inventory on hand and of production. Acts carried out pursuant to agreement reached under authority of Allocation Order M-195 are still valid as well as allocations or exceptions issued under M-195. Issued 11-15.

Office of Price Administration

SERVICING RAW NATURAL & SYNTHETIC RUBBER—GMPR, Rev. SR 14, Am. 51—Ceilings set for servicing of all types raw rubber which servicing was normally performed by members of Rubber Trade Assn. of New York, Inc. Servicers as of 6-15-43 must continue all services then included in the price effective that date. Others must follow servicing practice of most closely competitive supplier. To the ceilings ranging from 1/16c to 2c for plantation and wild rubbers in quantities of 750 T. to less than 1 ton, and ½c to 4c for balata, and corresponding ranges for synthetic, may be added 1/8c per pound for consolidated less than carload lots. Issued 11-16, effective 11-22.

SINCLAIR BARGE RENTAL INCREASE DENIED—GMPR, SR 15, Order 110—Increase of $25 from present $100 day rental sought by Sinclair for Delaware River and Bay barge rates at Philadelphia Harbor, because competitors' rates exceed Sinclair's. As operating costs established by Sinclair's submitted operating statements fail to show appreciable increase, application is denied. Issued and effective 11-5.

INEDIBLE LARD AND PORK FAT CEILINGS—MPR 53, Am. 8—Sellers who sold, prior to 1-1-43, over 75% of their pork fat and lard product for inedible use, may charge as maximum the price established by Article XIV of MPR 53 for grade and type which seller then designated it to be, or, lacking designation, price established for most nearly similar type of inedible fats. Issued 11-11, effective 11-17.

GRADE A CAMELBACK RETREADING—RPS 66, Am. 7—Ceilings for passenger tires retreaded with Grade A camelback established, ranging from $4.55 (plus $2.75 for furnishing carcass) for 3.75-18 size to $14.55 for 8.25-16 size. Issued 11-17, effective 11-23.

LIQUEFIED PETROLEUM GAS TANKWAGON INCREASE—RPS 88, Order 13—Tankwagon ceiling for liquefied petroleum gas raised 2c gallon for three Denver Colorado companies: Colorado Natural Gas & Fuel Co., Modern Appliance Co., and Farley Gas Co., because of discontinuance of former source of supply and increased costs in obtaining the gas at a distance, and of companies' loss of revenue from restrictions on sales of appliances. Issued and effective 11-5.

FUEL OIL INCREASE—RPS 88, Order 14—Application for increase granted Inland Empire Refiners, Inc., Spokane, in lesser amount than requested. Bulk deliveries of P. S. No. 300 and No. 400 fuel oil f.o.b. refinery set at $2.10 bbl. and $2.00 bbl. ceiling, (instead of requested $2.44 and $2.32) but District 5 deliveries may be increased by amount necessary to net Inland Empire at refinery an amount equal to these ceilings, determined by subtracting from delivered price the actual cost of transportation from Spokane. Increase based on increased raw material cost of from 8c to 20c bbl., as result of Wyoming crude increases. Issued and effective 11-5.

RENTAL CONSTRUCTION EQUIPMENT MPR 134, Am. 13—Cost of repairs and replacements is borne by lessee in the degree to which his use and possession contribute to necessity for such repairs, provided rental in such cases does not exceed 85% of applicable maximum. Thus lessee may be required to pay entire cost for repairs necessitated by climatic conditions, fire, tornado, etc., and to pay rental during repair period, and a proportion of repairs caused by normal wear and tear resulting from his use (as on tractor tracks), but not to pay for repairs necessitated by pre-existing or hidden defects, nor to pay rental during such repair period. Issued 11-24, effective 11-30.

ANTI-FREEZE SALES TO AND BY RETAILERS—MPR 170, Order 4—Boeing Airplane Co., Wichita Division, ordered to sell anti-freeze consisting of 15 parts glycerine and 85 parts methanol at 70c gal. delivered, drums included. Sales to retailers by any person shall be at 87c gal. delivered, drums included, and (except in case of Boeing Co.) transportation costs exceeding 5c gal. may be charged to buyer's account, if separately stated on invoice furnished buyer prior to payment. Retail sales set at $1.40 gal., and in quantities under 1 gallon, at 35c qt., both delivered, including installation in cooling system if buyer so requests, if this was customarily done without charge during 6 months prior to 3-31-42. Ceilings include charges for drums. Return may be required if $1.00 is deducted from specified ceiling, and $1.00 must also be deducted when buyer furnishes drums. Seller must bear transportation costs for return or furnishing of drums. D. A. Winters Tire Co. required to mark ceiling price and description of mixture on all drums, and all retailers must post ceiling and brand in a plainly visible and understandable manner. Issued 11-23, effective 11-24.

RECENT PRICE INTERPRETATIONS—(Released 10-10)

Proc. Reg. 6—Sale to customers in England who have British Govt. purchase permits for such transaction is not a sale under "Government contract".

MPR 28—Ethyl alcohol sales by seller owning more than one plant, all of them under contract to Defense Supplies Corporation, are considered sales by separate plants, which compute ceilings individually and report separately.

PS 49—Fabricators without warehouse status under M-21-b may not charge warehouse prices for plain material, but must base ceilings on Reg. 204 (Idle or Frozen Materials Sold under Pri. Reg. 13).

—Dealers making deliveries to a person at two adjoining plants in same city are mak-

NPN will appreciate hearing from its readers if they feel any pertinent regulations have been omitted from this page.

Copies of the complete text of the following orders can be obtained from PLATT'S OIL-Law-GRAM, 1213 W. Third St., Cleveland, Ohio

Minimum charge for single copies, $1, postage paid. One year's service, $100.

CODE: AO—Administrative Order; CMP—Controlled Materials Plan; D—Directive; FDO—Food Distribution Order; GMPR—General Maximum Price Regulation; GO—General Order; Interp.—Interpretation; L—Limitation Order; M—Conservation Order; MPR—Maximum Price Regulation; P—Preference Rating Order; PAO—Petroleum Administrative Order; Pri. Reg.—Priorities Regulation; Proc. Reg.—Procedural Regulation; PS—Price Schedule; RO—Ration Order; RPS—Revised Price Schedule; SO—Supplementary Order; SR—Supplementary Regulation.

ing delivery to only "one destination", since term refers to deliveries to general area of a city (the switching district), and not to individual points within city.

PS 96—Definition of "person" lists types of sellers of domestic fuel oil storage tanks coming under PS 96's jurisdiction, but does not exclude other types of sellers, such as retailers.

MPR 170—Sales of Types N and S antifreeze by jobber for his own account (not as manufacturer's agent) to another jobber or wholesaler exempt from price control.

MPR 411—Field assembled reusable steel storage tank ceilings include all ordinary attachments, such as vents, valves, etc. But preheaters, heating coils, etc. may be detached and charged for separately, as extras.

Reusable steel bolted tanks are listed according to barrel capacity, and numbers in "capacity" column refer to number of 42 U. S. gallon barrels which tank will contain.

MISCELLANEOUS GASOLINE RATIONING CHANGES—RO 5C, Am. 84—5C revised to conform to new policy of rationing in order to conserve gasoline, as well as rubber. Several sections are reworded and clarified, and obsolete provisions are revoked, including one on acknowledgments of delivery, on meaning of terms, and one certifying bank ration records and accounts as confidential. The application for additional rations for automobiles not giving 15 miles to the gallon is amended to conform to new limitations on non-preferred occupational mileage. Issued and effective 11-18.

CHANGE OF OWNERSHIP OF VEHICLE —RO 5C, Am. 85—New rationing procedure requires applicant for any type of ration for a motor vehicle which changes ownership after 12-31-43 to submit to Board duplicate copy of receipt (Form OPA R-569) upon first application. This receipt form is issued by Board to transferor upon surrender of all unused coupons, etc. at time of transfer of vehicle, and in its discretion may be issued without such surrender, upon being satisfied that no ration is outstanding, or that it is wrongfully withheld, or its surrender would cause undue hardship. R-569 must be given in duplicate upon transfer of vehicle to transferee, who presents original to Registrar of Motor Vehicles and duplicate to Board. Dealers holding for resale vehicles acquired before 1-1-44, without ration, must apply to Board for R-569 for each vehicle, not later than 1-11-44. R-569's issued for scrapped vehicles must be retained for 12 months. Issued 11-23, effective 12-1.

DEFINITE VALUE COUPONS—RO 11, Am. 89—Definite value Class 1 and 2 coupons void after 11-30-43. Other definite value coupons may be deposited at any time. Issued 11-26, effective 12-1.

War Production Board

SUPPLIERS' INVENTORY RESTRICTIONS —L-63, as am. 11-12-43—All suppliers must keep up-to-date records of total net monthly sales from stock, and total inventory at end of each month. Aggregate records, not separating each type of supplies, sufficient, with sales based on net selling prices, and inventory on cost including consigned stock, and excluding direct shipments. All such data must be preserved for two years, available for WPB inspection. Excluded from scope of L-63: automotive replacement parts, as defined in L-158, and automotive replacement batteries as defined in L-180, as well as replacement parts specially designed to fit only one model and brand of machinery. Issued 11-12.

STORAGE WATER HEATER TANKS— L-199, Interp. 2—Restrictions in main text of order apply to underfired storage water heater tanks, but none of attached schedules apply to such tanks. Issued 11-22.

ELECTRIC MOTORS AND GENERATORS —L-221, as am. 11-15-43—Newly excepted from jurisdiction of L-221 are: Starting motors and generators for internal combustion engines and generators for various power sets, such as frequency changers below 62½ cycles, synchronous condensers, hydroelectric generator sets, land use and marine auxiliary steam turbine generator sets, steam engine generator sets, land use Diesel engine and gas (not gasoline) engine generator sets of 750 RPM or less. Sales agencies and warehouses controlled by a manufacturer are defined as "manufacturers". Operating spares are now permitted for vital machinery. Deliveries of new motors permitted only if purchaser has no adaptable idle motor, other than operating spare, (and no spares totalling over 3% of operating motors of same class) and if purchaser has unsuccessfully attempted to obtain from at least three dealers a suitable used motor. Orders for new motors must be rated AA-5 or higher before acceptance. Specific standards set for new motors for which orders may be accepted, except military orders and those of machinery producers. Operating spare and new order restrictions not applicable to following motors: industrial truck, torque, traction (and generators), those used in operation of air-borne equipment, nor to frequency changers, 2-bearing motor-generator sets, dynamometers, rotary converters, motors and generators for military vessels or combat equipment. Issued 11-15.

TELEGRAM TO CAN MANUFACTURERS —M-81—WPB Containers Division waives provisions of Sec. C-1 to extent necessary to permit completion of manufacture of one and five-quart motor oil cans from frozen lithographed plate on hand as result of M-81-b's revocation. Manufacturers authorized to notify purchasers that such cans may be used for packing motor oil. Issued 11-6.

WAX—M-195, Revocation—M-195 reissued as PDO 19. *See* PAW orders. Issued 11-24.

SCHEDULED PRODUCTS—Indicating and Control Instruments—M-293, Table 9—Added to Table 9: capacitors for power factor correction, standard types of electrical test equipment and test instruments, set forth in lengthy detail, and designated as XY or Y Products. Issued 11-13.

OUTER SHIPPING CONTAINER MATERIALS——CMP 5, Interp. 4, Revocation— Superseded by Pri. Reg. 3, Direction 3. *See* below. Issued 11-19.

COMPULSORY ORDERS — Pri. Reg. 1, Interp. 4 as am. 11-18-43—When compulsory orders are placed with a producer of controlled materials Pri. Reg. 1 applies only to extent it does not interfere with acceptance and delivery of orders as permitted under CMP 1, paragraph (t) (3), i.e. authorized controlled materials orders, sample orders, or those required by WPB direction. Issued 11-18.

SMALL ORDER EXEMPTIONS—Pri. Reg. 1, Interp. 8—Branch stores or divisions normally keeping separate inventory from remainder of corporation may purchase up to their inventory limit, regardless of the excess stock of another branch, and may take advantage of small order exemptions for their individual stores, unless a distributor purchases centrally for direct shipment to several outlets (which may keep separate inventories), when computation of purchases must include all such outlets in one total. Issued 11-22.

APPLICATION AND EXTENSION OF PREFERENCE RATINGS—Pri. Reg. 3, as am. 11-17-43—Pri. Reg. 3 rephrased throughout, in simpler and more specific language. Ratings may not be extended to replace inventory if three months have passed from time purchaser could first have extended them. Ratings may not be used for labor or personal services (except services in course of a regular business involving use of equipment owned by supplier of services) except: on special WPB assignment to a named person for specified services; to secure processing of material; for repairs. List B, (items for which blanket MRO ratings may not be used) adds: blowers and industrial vacuum cleaners governed by L-222; under fabricated containers, all types bags—paper, textile, parchment, etc., baskets and hampers, tight and slack cooperage, fibre drums, gas cylinders, as defined in M-233, steel shipping drums as defined in L-197, wooden and fibre inner containers and containers and parts as defined in P-140; monorail systems (and additions of over $200 value); wire intercommunicating systems. Restrictions apply to items for which order is already placed, but not yet filled. Issued 11-17.

OUTER SHIPPING CONTAINER MATERIALS—Pri. Reg. 3, Direction 3 supersedes Interp. 4 of CMP 5.—Allotment symbols and preference ratings for MRO may be used to buy materials for making wooden crates and shipping containers for a shipper's own products but not for fabricated containers, cut-to-size parts of containers, fibreboard boxes, paper bags, etc. Captive plants may use such ratings assigned by CMP Reg. 5, 5A, or any order in P or U series only if less than 50,000 board ft. of lumber are bought for that purpose in each quarter. Persons not coming under these classifications may apply on Form CMP-4B, WPB-2613, etc. for ratings and allotments. Issued 11-13.

USE OF RATINGS FOR PROCESSING OF MATERIAL—Pri. Reg. 3, Interp. 7—Preference ratings cannot be used to secure processing of material by producer, warehouse, nor B product manufacturer. All MRO products, whether Class A or B, treated as Class B products. Ratings may be so applied to controlled materials producers only to the extent these rated orders for use of his facilities do not interfere with filling of his bona fide controlled materials orders. Issued 11-18.

DEADLINES FOR COMPRESSOR, PUMP, HEAT EXCHANGER ORDERS—Pri. Reg. 18, Direction 1—All persons who know they will need delivery in 1944 of any product in Groups A (internal combustion engine accessories and components) or B (engines, motors, generators, valves, etc.) must place all orders before 1-1-44 for delivery in first or second quarter of 1944, and before 3-1-44 for delivery in third or fourth quarters, but requested delivery in advance of required date is not authorized. Unfillable orders must be rejected by manufacturer. Late orders may be accepted only if rated AAA or specifically authorized by WPB, upon application in writing in triplicate, or authorization under M-293 or other such WPB order. Exceptions: Orders for MRO, for resale, for used products, for any Group B product ordered in amounts totaling under $10,000 in one quarter from one producer. Pumps and fuel injection equipment included in List A, and boilers (100 lbs. per sq. in.), compressors, Diesel engines, heat exchangers, high pressure and control valves, and industrial and marine pumps in List B.

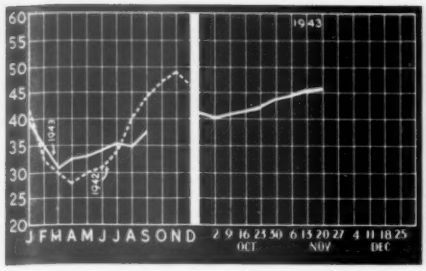
Defense Supplies Corporation

PETROLEUM COMPENSATORY ADJUSTMENTS—DSC Rev. Reg. 1, Am. 2—Crude or compensable products transported to and sold by DSC at a point in District 1 deemed imported by purchaser. In computing average cost of transit handling applicant may elect to compute weighted average substitute cost of in-transit handling for 6-month period ended 6-30 or 12-31 next preceding month for which application is filed, but once adopted such average must be used for next succeeding application. DSC also has right to adjust weighted average, upon final audit, to amount which would have been claimed if such 6-month average had not been used. Payments of 100% of accepted part of claim (instead of usual 75%) may be made if bond satisfactory to DSC has been furnished by applicant. Compensable intra-district movements are subject to reduction in value by the amount of any applicable revenue price increase except as to products purchased between 8-1 and 11-30-43 on which revenue has not been accounted for by a prior seller in District 1. Cost of in-transit handling occurring in normal method of transportation of importer shall be computed at *applicant's* average cost of in-transit handling for compensable intra-district movements from District 1 terminals on pipelines or those made from supply terminals outside area defined in Schedule "D". Beginning with November claims, revenue accounted for is reduced by sum equal to gallons of kerosine and various fuel oils which applicant moved by other than intra-district movement to points in New England and certain eastern states, multiplied by $.001, except rail, barge, or lake steamer importations. Claims for period between 8-1 and 9-15-43 may use as basis original Regulation 1, or as amended by Amendments 1 and 2. Issued 11-18.

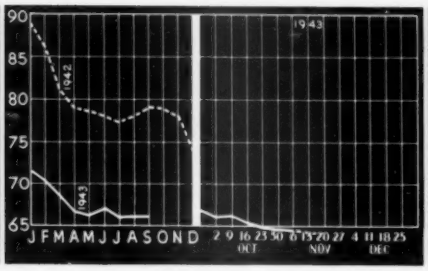
Executive Orders

DISCRIMINATION CLAUSE, GOVERNMENT CONTRACTS—E. O. 9346, Construction of—Letter from President Roosevelt to Attorney General Biddle states that non-discrimination because of race, creed, or color clause is mandatory in Government contracts, and not directive only, as held in Comptroller General's opinion. Issued 11-5, released 11-10.

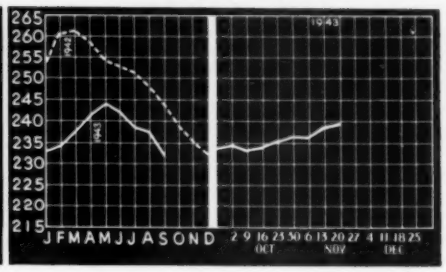
Gas Oil and Distillate Stocks



Residual Fuel Oil Stocks



Crude Stocks



Refinery Operations

(American Petroleum Institute figures in thousands of barrels of 42 gal. each. Figures include reported totals plus estimate of unreported amounts and are therefore on a Bureau of Mines basis.)

Districts	Daily Potential Refining Capacity Week Ended Nov. 20	Daily Potential Refining Capacity Week Ended Nov. 13	Per Cent of Refining Capacity Reporting Week Ended Nov. 20	Per Cent of Refining Capacity Reporting Week Ended Nov. 13	Daily Average Crude Runs to Stills Week Ended Nov. 20	Daily Average Crude Runs to Stills Week Ended Nov. 13	Per Cent of Reporting Capacity Operated Week Ended Nov. 20	Per Cent of Reporting Capacity Operated Week Ended Nov. 13
Combined°°	2,444	2,444	88.7	88.7	2,164	2,094	88.5	85.7
Appalachian (Dist. No. 1)	130	130	83.9	83.9	94	103	72.3	79.2
Appalachian (Dist. No. 2)	47	47	87.2	87.2	49	34	104.3	72.3
Ind., Ill., Ky.	824	824	85.2	85.2	737	736	89.4	89.3
Okla., Kans., Mo.	416	416	80.1	80.1	351	350	84.4	84.1
Rocky Mt. (Dist. No. 3)	8	8	26.9	26.9	9	8	112.5	100.0
Rocky Mt. (Dist. No. 4)	141	141	58.3	58.3	92	97	65.2	68.8
California	817	817	89.9	89.9	696	712	85.2	87.1
Total U. S.—B. of M. Basis	4,827	4,827	86.4	86.4	4,192	4,134	86.9	85.6
U. S.—B. of M. Basis Nov. 21, 1942					3,731			

Districts	Gasoline Production at Refineries Inc. Natural Blended Week Ended Nov. 20	Gasoline Production at Refineries Inc. Natural Blended Week Ended Nov. 13	Stocks of Finished and Unfinished Gasoline Week Ended Nov. 20	Stocks of Finished and Unfinished Gasoline Week Ended Nov. 13	Total Stocks Gas Oil & Distillates Week Ended Nov. 20	Total Stocks Gas Oil & Distillates Week Ended Nov. 13	Total Stocks Residual Fuel Oil Week Ended Nov. 20	Total Stocks Residual Fuel Oil Week Ended Nov. 13
Combined°°	6,012	5,889	31,058	30,564	23,022	22,710	18,560	18,398
Appalachian (Dist. No. 1)	288	324	1,538	1,596	963	936	177	202
Appalachian (Dist. No. 2)	124	127	734	794	124	119	146	118
Ind., Ill. Ky.	2,591	2,472	13,336	13,077	6,639	6,609	2,936	3,003
Okla., Kans., Mo.	1,275	1,239	6,788	6,800	2,344	2,498	1,187	1,215
Rocky Mt. (Dist. No. 3)	33	29	66	64	22	21	33	34
Rocky Mt. (Dist. No. 4)	362	348	1,131	1,080	440	438	714	677
California	1,803	1,795	14,345	14,751	12,218	11,985	38,909	39,000
Total U. S.—B. of M. Basis	12,488	12,223	68,996°	68,610†	45,772	45,518‡	62,662	62,647
U. S.—B. of M. Basis Nov. 21, 1942	11,482		74,745		50,085		77,796	

°Finished 58,901,000 bbl.; Unfinished 10,095,000 bbl.

°°Includes East Coast, Inland Texas, Texas Gulf, Louisiana Gulf, and North Louisiana-Arkansas districts.

†Unfin. Gas. Stocks Revised Downward by 116,000 gal. in California.

‡On new basis in California, due to inclusion of 202,000 Gal. not previously reported. District No. 1 inventory indices are: Gasoline, 39.5%, Kerosine, 52.3%, Gas, Oil & Distillate Fuel, 64.2%, Residual Fuel Oil, 76.3% of Norma[1]

Crude Oil Stocks

(Bureau of Mines Figures in thousands of bbls.)

Grade or Origin	Nov. 20	Nov. 13	Change from Nov. 13
Penna. Grade	2,542	2,518	+ 24
Other Appalachian	1,484	1,523	— 39
Lima-Michigan	1,064	1,047	+ 17
Illinois-Indiana	12,027	12,053	— 26
Arkansas	3,126	3,137	— 11
Kansas	7,939	8,239	—300
Louisiana:	14,404	13,903	+501
Northern	4,530	4,398	+132
Gulf Coast	9,874	9,505	+369
Mississippi	1,014	1,089	— 75
New Mexico	8,042	7,692	+350
Oklahoma	33,798	33,725	+ 73
Texas:	107,938	107,678	+260
East Texas	23,007	23,316	—309
West Texas	25,820	25,738	+ 82
Gulf Texas	32,404	32,312	+ 92
Other Texas	26,707	26,312	+395
Panhandle	6,652	6,520	+132
North	5,535	5,445	+ 90
South	5,285	5,340	— 55
Other	9,235	9,007	+228
Rocky Mt.	12,258	12,131	+127
California	32,772	32,583	+189
Foreign	1,461	1,086	+375
Total gasoline-bearing in U. S.	239,869	238,404	+1,465
Heavy in California	8,593	8,653	— 60

U. S. Crude Oil Production

(American Petroleum Institute figures in Bbls.)

	WEEK ENDED Nov. 20 Barrels (Daily Average)	WEEK ENDED Nov. 13 Barrels (Daily Average)
Oklahoma	326,650	327,700
Kansas	281,350	288,900
Nebraska	1,700	1,700
Texas	1,924,200	1,924,200
Louisiana	350,950	350,850
Arkansas	78,350	78,550
Mississippi	46,800	52,550
Illinois	215,250	215,500
Indiana	12,500	13,150
Eastern (Ill., Ind. & Ky. excluded)	71,100	71,000
Kentucky	23,350	22,350
Michigan	50,100	60,600
Wyoming	100,850	100,950
Montana	21,350	21,350
Colorado	7,450	7,300
New Mexico	112,950	112,550
California	789,500	787,300
Total, United States	4,414,400	4,436,450

Pennsylvania Crude Runs

(Compiled by National Petroleum Assn. from reports of all companies refining Pennsylvania crude. Figures in bbls.)

Week ended	Daily Average	Week ended	Daily Average
Feb. 6	67,494	July 10	75,188
Feb. 13	69,103	July 17	73,150
Feb. 20	78,797	July 24	62,047
Feb. 27	77,285	July 31	64,011
Mar. 6	70,389	Aug. 7	57,594
Mar. 13	73,184	Aug. 14	67,191
Mar. 20	77,828	Aug. 21	79,917
Mar. 27	82,224	Aug. 28	78,000
Apr. 3	81,095	Sept. 4	72,236
Apr. 10	74,317	Sept. 11	72,743
Apr. 17	70,445	Sept. 18	75,420
Apr. 24	76,625	Sept. 25	82,851
May 1	76,555	Oct. 2	72,485
May 8	77,088	Oct. 9	66,904
May 15	79,366	Oct. 16	69,008
May 22	76,684	Oct. 23	76,517
May 29	76,488	Oct. 30	76,641
June 5	71,505	Nov. 6	59 868
June 12	76,768	Nov. 13	69,133
June 19	68,115	Nov. 20	63,856
June 26	69,551	1942 Low	67,243
July 3	68,542	1942 High	87,251

N.P.N. Gasoline Index

	Dealer T.W. Cents	Tank Car Per Gal.
Nov. 29	10.45	6.92
Month ago	10.45	6.92
Year ago	10.47	6.50

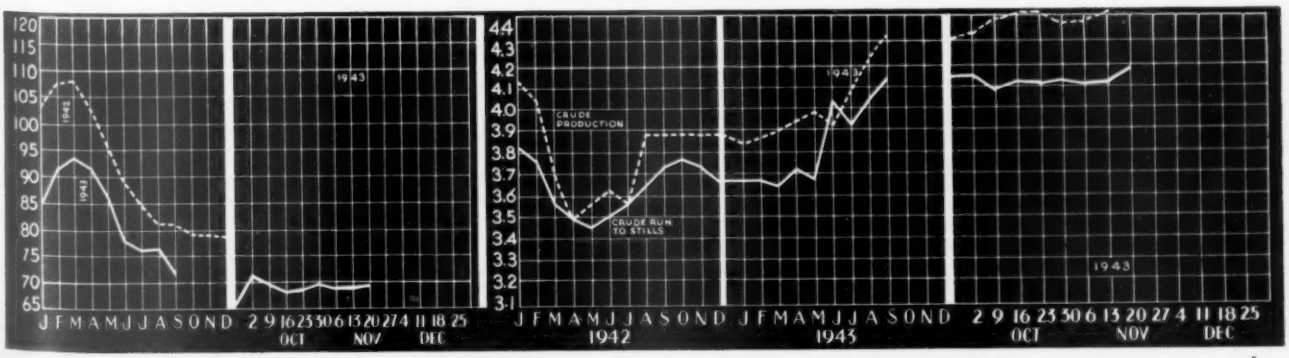
Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

Tank car index is weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

Gasoline Stocks

(Finished and Unfinished)

Crude Production and Runs to Stills


1943
1942
1943
CRUDE PRODUCTION
CRUDE RUN TO STILLS
1943
J F M A M J J A S O N D
2 9 16 23 30 6 13 20 27 4 11 18 25
OCT NOV DEC
J F M A M J J A S O N D J F M A M J J A S O N D
1942 1943

Crude Stocks Show Increase

NPN News Bureau

WASHINGTON—Stocks of domestic and foreign crude totaled 239,869,000 bbls. on Nov. 20 compared with 238,404,000 bbls. the previous week, the Bureau of Mines reported on Nov. 29.

Major increases were in Louisiana, up 501,000 bbls.; "foreign", up 375,000 bbls.; New Mexico, up 350,000 bbls. Texas, up 260,000 bbls. and California, up 189,000 bbls. Only large drop was Kansas, down 300,000 bbls. Other area changes were slight.

19,787,561 Gal. 'Gas' Sold

BISMARCK, N. D.—Tax collections in North Dakota during the month of October totaled $249,796.38, with taxable gasoline sold amounting to 6,306,526 gals. and tax-exempt gasoline sales totaling 13,481,035 gals. Report was made by the North Dakota Petroleum Industries Committee.

Market Reports

ATLANTIC COAST—Gasoline situation as reported by East Coast suppliers was spotty throughout week, with demand for housebrand emphasized. Kerosine and No. 2 fuel were said to be comfortable. One supplier in Boston who had hiked his quotation from 6.7 to 6.9 on diesel, shore plants, the previous week, temporarity lowered it to 6.7. One other supplier is quoting this price. No other changes reported.

° ° °

CALIFORNIA—All prices are reported firm. Gasoline is very tight with lowest quotations being 6c, 6.5c and 7.5c for the three grades. Fuel oil is also tight with all quotations at the ceiling price of $1.10 per barrel.

° ° °

MID-CONTINENT — Lows of price ranges in Kansas for 72 oct., 63-66 oct. and 60 & below oct. gasoline were raised and highs of ranges of 42-44 w.w. kerosine and No. 1 p.w. were lowered when refiner reported changing postings to the following: 76 oct. Ethyl 7.5c, 72 oct. 6.3c, 63-60 oct. 5.9c, 60 & below oct. 5.5c, 42-44 w.w. kerosine 4.7c; and No. 1 p.w. 4.1c. New price ranges are: 72 oct. 6.25-6.3c, 63-66 oct. 5.9c, 60 & below oct. 5.5c, 42-44 w.w. kerosine 4.625-4.7c, No. 1 p.w. 4-4.1c. Ethyl range of 7.25-7.5c was unaffected.

Gasoline demand is reported dropping off in some areas, continuing at high level of last 60 days in other parts of Mid-Continent. Heavy fuel oil is much in demand by industrial plants as operating difficulties of natural gas companies have caused many concerns to turn to oil, several Kansas refiners said, adding that they were unable to help them very much. Asphalt demand is tapering off now, reports indicate.

Sixteen cars Grade 26-70 natural gasoline were reported sold at 4.75c f.o.b. Group 3, and 25 cars were reported sold at 4.375c f.o.b. Breckenridge.

° ° °

PENNSYLVANIA—Western Penna. refiner reported raising his quotation for "Q" gasoline in the lower field 0.25c to 7.75c, leaving price range unaffected.

Majority of refiners were said to be quoting higher than range lows on neutrals and one refiner raised his quotation for 150 vis. 25 p.t. 1.5c to 29.5c, establishing new price range of 25-29.5c for that product. Heavy military consumption and steady civilian demand brought about tightening in petrolatums was general report of refiners.

° ° °

MID-WEST — Several Michigan and Chicago area refiners agreed that present supplies of domestic fuel oils at Great Lakes marine terminals are in better condition than they have been for some time. Refinery storages are reported still dangerously low, however. With shortage of gasoline and domestic fuels and increasingly strong demand for both lubricating oils and industrial oils, refiners in Chicago area are considering use of sour crude in cases where they will receive compensatory adjustment in transportation costs. Michigan refiners, however, are temporarily discarding the idea because, they say, of difficulty in transporting it that far and trouble involved in running it. Prices showed no change over the week.

° ° °

GULF COAST—Except for continued buying and selling of Bunker C fuel oil Gulf market remained inactive. No new quotations were reported by refiners.

CRUDE PRICES

Since changes in crude oil prices are so few, the 2 pages of crude oil price tables hereafter will be printed only when there are sufficient changes in prices to warrant.

In the meantime a record is being kept in the Cleveland office of NPN and OILGRAM from which the publishers will be glad to make proofs, or letters or affidavits as to what the prices are, and without charge to regular subscribers. Changes in crude oil prices will be specially noted in this market section when made.

Crude Price Changes

(No changes reported during week ended Dec. 1. For latest tables of crude prices see NPN Nov. 24, pages 52, 53.)

Summary of Daily Gasoline Prices (November 22 to November 29)

	Monday Nov. 29	Friday Nov. 26	Thursday Nov. 25	Wednesday Nov. 24	Tuesday Nov. 23
U. S. Motor (ASTM octane)					
76 octane Ethyl:					
Oklahoma	6.75 - 6.875	6.75 - 6.875	6.75 - 6.875	6.75 - 6.875	6.75-7.25
Mid-Western (Group 3 basis)	6.75 - 7.25	6.75 - 7.25	6.75 - 7.25	6.75 - 7.25	7
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7	7	7	7	7
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7 (2)	7 (2)	7 (2)	7 (2)	7 (2)
72 octane:					
Oklahoma	6	6	6	6	6
Mid-Western (Group 3 basis)	6	6	6	6	6
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
63-66 octane:					
Oklahoma	5.625 (2)	5.5 - 5.625	5.625 (2)	5.625 (2)	5.625 (2)
Mid-Western (Group 3 basis)	5.6 - 5.625	5.5 - 5.625	5.5 - 5.625	5.5 - 5.625	5.5 - 5.625
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.75 (1)	5.75 (1)	5.75 (1)	5.75 (1)	5.75 (1)
60 octane & above:					
Oklahoma	5.25	5.125- 5.25	5.25	5.25	5.25
Mid-Western (Group 3 basis)	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.2 - 5.25	5.2 - 5.25	5.125- 5.25	5.2 - 5.25	5.2 - 5.25
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.25	5.25	5.25	5.25	5.25
Motor Gasoline, 72 octane (ASTM)					
New York harbor	9.2 - 9.4	9.2 - 9.4	9.2 - 9.4	9.2 - 9.4	9.2 - 9.4
New York harbor, barges	9.1 - 9.3	9.1 - 9.3	9.1 - 9.3	9.1 - 9.3	9.1 - 9.3
Philadelphia district	9.2	9.2 - 9.7	9.2 - 9.7	9.2 - 9.7	9.2 - 9.7
Baltimore district	8.95	8.95	8.95	8.95	8.95
Motor Gasoline:					
Western Penna. Bradford-Warren:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.5 - 8.95	7.5 -7.75 (2)	7.5 - 8.95	7.5 - 8.95	7.5 - 8.95
Western Penna. Other Districts:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.5 - 7.75	7.5 - 7.75	7.5 - 7.75	7.5 - 7.75	7.5 - 7.75

OIL PRICE SECTION ★ At Refineries and Terminals and by Tank Wagon

Prices herewith are reproduced from Platt's *OILGRAM* Daily Oil Price Service, associated with National Petroleum News, whose representatives in all *NPN-OILGRAM* offices devote their time exclusively to reporting oil industry prices everywhere.

Prices shown are actual sales prices, or quotations meaning sellers' general offers or posted prices; for current sales and shipment; for the business day or period stated; except Tank Wagon prices, prices are for bulk lots such as tank car and motor transport; barge or tanker cargo lot prices are identified; FOB refineries or terminals; in cents per gal. except where shown in bbls. of 42 gals.; ex all fees and taxes; for crude oil and its products lawfully produced and transported; reported as received by *OILGRAM* and National Petroleum News but not guaranteed; for subscribers' private use only and not for resale or distribution or publication. For further details of price conditions apply to any *NPN-OILGRAM* office or see back of any *OILGRAM* Price Service invoice.

For complete price service delivered daily from nearest *OILGRAM* publishing office, New York, Cleveland and Tulsa, Okla. address Platt's *OILGRAM*, 1213 W. 3rd St., Cleveland (13), Ohio. Annual subscription rate payable in advance $100 a year via train mail and $125 per year via air mail.

Refinery Prices

Gasoline —U. S. Motor (A S T M) except where otherwise specified

Prices in Effect	Nov. 29	Nov. 22
OKLAHOMA		
76 oct. Ethyl	6.75	6.75
72 oct	6	6
63-66 oct	5.625 (2)	5.625 (2)
60 oct. & below	5.25	5.25
60-62, 400 e.p.	5.25 (1)	5.25 (1)
MID-WESTERN (Group 3 basis)		
76 oct. Ethyl	6.75 – 7.25	6.75 – 7.25
72 oct	6	6
63-66 oct	5.6 – 5.625	5.6 – 5.625
60 oct. & below	5.2 – 5.25	5.2 – 5.25
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
76 oct. Ethyl	7	7
72 oct	6	6
63-66 oct	5.625 (1)	5.625 (1)
60 oct. & below	5.2 – 5.25	5.2 – 5.25
60-62 400 e.p.	5.375 (1)	5.375 (1)
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
76 oct. Ethyl	6.75 – 7 (2)	6.75 – 7 (2)
72 oct	6	6
63-66 oct	5.75 (1)	5.75 (1)
60 oct. & below	5.25	5.25
CENT. W. TEX. (Prices to truck transports)		
76 oct.	7 (2)	7 (2)
72 oct.	6 (2)	6 (2)
67-69 oct.	....	....
62 oct. & below	5.25 (2)	5.25 (2)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
60 oct. & below	No Price	No Price
60-62, 400 e.p.	No Price	No Price
KANSAS (For Kansas destinations only)		
76 oct. Ethyl	7.25 – 7.5 (2)	7.25–7.5 (2)
72 oct.	6.25 – 6.3	6 – 6.3 (2)
63-66 oct.	5.9 (2)	5.625–5.9 (2)
60 oct. & below	5.5	5.25 – 5.5 (2)
ARK. (For shipment to Ark. & La.)		
72 oct., leaded	6 (1)	6 (1)
70-72 oct. "	5.875 (1)	5.875 (1)
62 oct. "	5.5 (1)	5.5 (1)
60 oct. & below, leaded	5.5 (1)	5.5 (1)
WESTERN PENNA. (Motor gasoline)		
Bradford-Warren: "Q" Gasoline, Min. 70 Oct. (ASTM)	7.5 – 8.95	7.5 – 8.95
Other districts: "Q" Gasoline, Min. 70 Oct. (ASTM)	7.5 – 7.75	7.5 – 7.75
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
U.S. Motor: (Oct. ASTM):		
72 oct.	8 – 8.5	8 – 8.5
67-69 oct.	....	....
Str. run gasoline, excluding Detroit shpt.	6	6
OHIO (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances).		
72 oct.	8.375	8.375
CALIFORNIA U.S. Motor:		
76 oct. (Ethyl)	7 – 8.75	7 – 8.75
70-72 oct. (regular)	6 – 7.75	6 – 7.75
65 oct. & below (3rd grade)	5 – 6.75	5 – 6.75

Kerosine, & Gas Fuel Oils

Prices in Effect	Nov. 29	Nov. 22
OKLAHOMA		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5	4.5
Range Oil	4 – 4.125	4 – 4.125
No. 1 P.W.	....	....
No. 1 straw	....	....
No. 2 straw	3.625	3.625
No. 3 fuel	3.5 (2)	3.5 (2)
U. G. I. Gas Oil	....	....
No. 6 fuel	....	....
14-16 fuel	$0.97 (2)	$0.97 (2)
MID-WESTERN (Group 3 basis)		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5	4.5
Range Oil	4 –4.1 (2)	4 –4.1 (2)
No. 1 p.w.	3.875	3.875
No. 2 straw	3.625	3.625
No. 3	3.5 (1)	3.5 (1)
No. 5	$0.85 (1)	$0.85 (1)
No. 6	$0.80 (2)	$0.80 (2)
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
41-43 grav. w.w.	4 (1)	4 (1)
No. 1 P.W.	4.2 (1)	4.2 (1)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
41-43 grav. w.w.	No Price	No Price
No. 1 straw	No Price	No Price
KANSAS (For Kansas destinations only).		
41-43 grav. w.w.	No Price	No Price
42-44 grav. w.w.	4.625– 4.7	4.625– 4.875
No. 1 p.w.	4 – 4.1	4 – 4.25
No. 6 fuel	$0.85 (2)	$0.85 (2)
ARK. (For shipment to Ark. and La.)		
41-43 grav. w.w.	4.625 (1)	4.625 (1)
No. 1	4 (1)	4 (1)
No. 2	3.5 (1)	3.5 (1)
No. 3 fuel	3.5 (1)	3.5 (1)
Tractor fuel, for shpt. to Ark. points only	5.125 (1)	5.125 (1)
WESTERN PENNA.		
Bradford-Warren:		
45 grav. w.w.	6.55 – 8.05	6.55 – 8.05
46 grav. w.w.	6.675 (1)	6.675 (1)
No. 1 fuel	6.55 – 8.05	6.55 – 8.05
No. 2 "	6.625–7.625(2)	6.625–7.625(2)
No. 3 "	6.625–7.75 (2)	6.625–7.75 (2)
36-40 gravity	6.625–6.75 (2)	6.625–6.75 (2)
Other districts:		
45 grav. w.w.	6.75 – 7.925	6.75 – 7.925
46 grav. w.w.	6.875– 7	6.875– 7
47 grav. w.w.	7 – 7.25	7 – 7.25
No. 1 fuel	6.625	6.625
No. 2 "	6.5 – 7.125	6.5 – 7.125
No. 3 "	6.5 – 7.125	6.5 – 7.125
36-40 grav., Pittsburgh dist. prices excluded	6.5 – 7	6.5 – 7
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
47-49 gravity w.w.	5.8 – 6	5.8 – 6
P.W. Distillate	5.5	5.5
No. 3 gas oil, Straw	5	5
U.G.I. gas oil	4.5 (2)	4.5 (2)
Fuel Oils (*Vis. at* 100).		
300-500 Vis.	....	....
100-300 Vis.	4.5	4.5
OHIO (S. O. quotations for statewide delivery)		
Kerosine	7	7
CALIFORNIA		
40-43 grav. w.w.	5 – 7	5 – 7
San Joaquin Valley:		
Heavy fuel	$1.10 (2)	$1.10 (2)
Light fuel	$1.20 (2)	$1.20 (2)
Diesel fuel	4 (2)	4 (2)
Stove dist.	5 (2)	5 (2)
Los Angeles:		
Heavy fuel	$1.10 (2)	$1.10 (2)
Light fuel	$1.20 (2)	$1.20 (2)
Diesel fuel	4 (2)	4 (2)
Stove dist.	5	5
San Francisco:		
Heavy fuel	$1.15 (1)	$1.15 (1)
Light fuel	$1.25 (1)	$1.25 (1)
Diesel fuel	4.5 (1)	4.5 (1)
Stove dist.	5.5 (1)	5.5 (1)

NOTE: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

Lubricating Oils

Prices in Effect	Nov. 29	Nov. 22
WESTERN PENNA.		
Prices are for sales made, or offers reliably reported, to jobbers & compounders only. **Viscous Neutrals**—*No. 3 col. Vis. at* 70°*F.*		
200 Vis. (180 at 100°) 420-425 fl.		
0 p.t.	33 (1)	33 (1)
10 p.t.	32 (1)	32 (1)
15 p.t.	31 (1)	31 (1)
25 p.t.	27-31.5	27-31.5
150 Vis. (143 at 100°) 400-405 fl.		
0 p.t.	31 (1)	31 (1)
10 p.t.	30 (1)	30 (1)
15 p.t.	29 (1)	29 (1)
25 p.t.	25-28.5	25-28.5
Cy inder Stocks		
Brt. stk., 145-155 *vis. at* 210°, 540-550 fl., *No. 8 col.*		
10 p.t.	30.5 (1)	30.5 (1)
15 p.t.	29.5 (1)	29.5 (1)
25 p.t.	25	25
600 S.R. filterable	15	15
650 S.R.	15.5	15.5
600 fl.	16	16
630 fl.	17	17
MID-CONTINENT (F. o. b. Tulsa)		
Neutral Oils (*Vis. at* 100° *F. 0 to* 10 *P.P.*)		
Pale Oils:		
Vis. Color		
60-85—No. 2	8	8
86-110—No. 2	8.5	8.5
150—No. 3	14.5	14.5
180—No. 3	15	15
200—No. 3	15	15
250—No. 3	16–16.5	16–16.5
280—No. 3	17	17
300—No. 3	18	18
Red Oils:		
180—No. 5	15 (1)	15 (1)
200—No. 5	15 (1)	15 (1)
280—No. 5	No Price	No Price
300—No. 5	17.5 (2)	17.5 (2)

Note: Viscous Neutrals, 15-25 p.p. generally are quoted 0.5c under 0-10 p.p. oils. Non-viscous oils, 15-25 p.p.; generally are quoted 0.25c under 0-10 p.p. oils.

Bright Stock—*Vis. at* 210°		
200 Vis. D	27 (1)	27 (1)
150-160 Vis. D:		
0 to 10 p.p.	23	23
10 to 25 p.p.	22.5-23	22.5-23
25 to 40 p.p.	23 (1)	23 (1)
150-160 Vis. E	22 (1)	22 (1)
120 Vis. D:		
0 to 10 p.p.	22 (2)	22 (2)
600 S.R. Dark Green	8.5 (1)	8.5 (1)
600 S.R. Olive Green	10-11	10-11
631 S.R.	.....	.....
Black Oil	5.5 (1)	5.5 (1)

QUALIFYING PRICE NOTE: Prices on neutrals are posted prices from which refiners allow special discounts, ranging to 1c to meet varying local competition.

SOUTH TEXAS Neutral Oils		
Pale Oils (*Vis. a* 100°*F.*)		
Vis. Color		
100 No. 1½-2½	6.5	6.5
200 No. 2-3	8.75	8.75
300 No. 2-3	9.25	9.25
500 No. 2½-3½	10	10
750 No. 3-4	10.25	10.25
1200 No. 3-4	10.375	10.375
2000 No. 4	10.5	10.5

(Continued on next page)

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown) bids reported in market leads.

Refinery Prices (Continued)

Prices in Effect	Nov. 29	Nov. 22
Red Oils:		
100 No. 5-6	6.5 (2)	6.5 (2)
200 No. 5-6	8.75	8.75
300 No. 5-6	9.25	9.25
500 No. 5-6	10	10
750 No. 5-6	10.25	10.25
1200 No. 5-6	10.375	10.375
2000 No. 5-6	10.5-11.5	10.5-11.5

CHICAGO (From Mid-Continent p.l. crude.)
Neutral oils (*Vis. at* 100° *F. 0 to* 10 p.p.)

Pale Oils Vis. Color		
60-85—No. 2	9.5 (1)	9.5 (1)
86-110—No. 2	10 (1)	10 (1)
150—No. 3	15.5 (1)	15.5 (1)
180—No. 3	16 (1)	16 (1)
200—No. 3	16 (1)	16 (1)
250—No. 3	17 (1)	17 (1)
Red Oils:		
180—No. 5	16 (1)	16 (1)
200—No. 5	16 (1)	16 (1)
250—No. 5	17 (1)	17 (1)
280—No. 5	18 (1)	18 (1)
300—No. 5	18.5 (1)	18.5 (1)

Note: Viscous oils, 15 to 30 p.p. are quoted 0.5c lower: 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

Unfiltered Steam Refined: (*Viscosity at* 210°)		
140	11.5 (1)	11.5 (1)
160	12.5 (1)	12.5 (1)
200	13.5 (1)	13.5 (1)
Bright stocks, 160 *vis. at* 210 *No.* 8 *color:*		
0 to 10 p.p.	24 (1)	24 (1)
15 to 25 p.p.	23.5 (1)	23.5 (1)
30 to 40 p.p.	21.5 (1)	21.5 (1)
E filtered Cyl. Stock	15.5 (1)	15.5 (1)

Note: To obtain prices delivered in Chicago, add 0.25c per gal.

Natural Gasoline

(Group 3 & Breckenridge prices are to blenders on freight basis shown below. Shipments may originate in any Mid-Continent manufacturing district.)

FOB GROUP 3

Grade 26-70 ..... 4.75 (Sale) 4.75 (Sale)

FOB BRECKENRIDGE

Grade 26-70 ..... 4.375 (Quote) 4.375 (Quote)

CALIFORNIA (FOB plants in Los Angeles basin)

21 pound vapor pressure for blending	4.75 - 5.375	4.75 - 5.375

Naphtha and Solvent

(*FOB Group* 3)

Stoddard solvent	6.625	6.625
Cleaners' naphtha	7.125	7.125
V. M. & P. naphtha	7.1 - 7.125	7.1 - 7.125
Mineral spirits	6.1 - 6.125	6.1 - 6.125
Rubber solvent	7.1 - 7.125	7.1 - 7.125
Lacquer diluent	7.375- 8.125	7.375- 8.125
Benzol Diluent	8.375- 8.625	8.375- 8.625

WESTERN PENNA.

Bradford-Warren District:		
Stoddard Solvent	7.5 (1)	7.5 (1)
Other Districts:		
Untreated naphtha	7 - 7.25	7 - 7.25
Stoddard solvent	7.25 - 7.75	7.25 - 7.75

OHIO (S. O. quotations for statewide delivery): V.M.&P. naphtha, D.C. naphtha, Varnolene &

Sohio solvent	10	10
Rubber solvent	9	9

Wax

WESTERN PENNA. (Bbls. C.L.)

White Crude Scale:		
122-124 A.m.p.	4.25 (2)	4.25 (2)
124-126 A.m.p.	4.25	4.25

OKLAHOMA (C.L. FOB Refinery)

Semi-refined:		
128 AMP min, white, 50 kilo bags	No Price	No Price
132-134 AMP, bbls.	5.25 (1)	5.25 (1)

CHICAGO (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

Fully refined:		
122-124 (bags only)	5.6	5.6
125-127	6	6
127-129	6.25	6.25
130-132	6.55	6.55
132-134	6.8	6.8
135-137	7.55	7.55

Petrolatums

WESTERN PENNA. (Bbls., carloads; tank cars, 0.5c per lb. less.)

Snow White	6.125- 7.25	6.125- 7.25
Lily White	5.375- 6.25	5.375- 6.25
Cream White	4.375- 5.5	4.375- 5.5
Light Amber	3.375- 4	3.375- 4
Amber	3.125- 3.75	3.125- 3.75
Red	3 - 3.5	3 - 3.5

Tank Wagon Prices

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include taxes;** *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes also city and county taxs as; indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect Nov.* 29, 1943 *as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

S. O. N. J. — **Esso** (*Regular Grade*)

	Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
*Atlantic City, N. J.	10.2	10.7	4.5	10
*Newark, N. J.	10.2	10.7	4.5	10
Annapolis, Md.	10.55	11.05	5.5	....
Baltimore, Md.	9.95	10.45	5.5	10.8
Cumberland, Md.	11.35	11.85	5.5	12.3
Washington, D. C.	10.2	10.7	4.5	11.3
Danville, Va.	11.65	12.15	6.5	12.55
Norfolk, Va.	10.45	10.95	6.5	12.3
Petersburg, Va.	10.75	11.25	6.5	13.3
Richmond, Va.	10.75	11.25	6.5	13.3
Roanoke, Va.	11.95	12.45	6.5	12.8
Charleston, W. Va.	12.25	12.75	6.5	13.6
Parkersburg, W. Va.	11.55	12.05	6.5	13.3
Wheeling, W. Va.	11.55	12.05	6.5	13.9
Charlotte, N. C.	12.1	12.6	7.5	11.6
Hickory, N. C.	12.65	13.15	7.5	12.6
Mt. Airy, N. C.	12.5	13.0	7.5	11.8
Raleigh, N. C.	11.85	12.35	7.5	12.6
Salisbury, N. C.	12.15	12.65	7.5	13.0
Charleston, S. C.	10.95	11.45	7.5	....
Columbia, S. C.	11.8	12.3	7.5	....
Spartanburg, S. C.	12.5	13.0	7.5	....

	Mineral Spirits T.W.	V.M.&P. T.W.
Newark, N. J.	13	14.5
Baltimore, Md.	15.5	....
Washington, D. C.	15.5	....

Fuel Oils—T.W.	No. 1	No. 2	No. 3
Atlantic City, N. J.	10	9	9
Newark	10	9	9
Annapolis, Md.	..	9.25	...
Baltimore	9.8	9	9
Washington, D. C.	10.3	9.4	9.4
Norfolk, Va.	10	8.8	8.8
Petersburg	10.3	9	...
Richmond	10.3	9	9
Charlotte, N. C.	10.6	10.4	...
Hickory, N. C.	....	10	...
Raleigh	11.6	10.1	...
Charleston, S. C.	....	9	...
Columbia	....	10	...
Spartanburg	....	10.8	...

*Effective Aug. 5, '42 minimum retail resale price of 14.2c posted thru New Jersey. Discounts;

Esso gasoline—to undivided dealers, 0.5c off dealer t.w.

Kerosine—1c off t.w. price for 25 gals. or more, under contract thru territory (Baltimore city contract not necessary) except no discount in state of New Jersey.

Naphthas—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals, 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

(N.B. Prices are Continental's "structural" prices. Prices do not reflect temporary reductions made to meet local competition.)

Notice

These prices include inspection fees on both gasoline and kerosine unless otherwise specified per gallon as follows:

Ala. 1/40c on gasoline, 1/2c on kerosine; Ark. 1/20c; Fl. 1/8c; Ill. 3/100c; Ind. 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 25 bbls.; Kans. 1/50c; La. 1/32c; Minn. 7/200c; Mis. 1/50c; Neb. 2/100c; Nev. gasoline 1/20c; N. C. 1/4c; N. Da. 1/20c; Okla. 2/25c; S. Car. 1/8c; S. Da. 1/20c; Tenn. 2/5c; and Wisc. 3/100c.

Kerosine inspection fees only: Iowa 3/50c; Mich. 1/5c per gal.

CONT'L OIL

	†Tank Wagon (Reg.)	Dealer (3rd Grade)	Gasoline Taxes	Kerosine T.W.
Denver, Col.	11	10	5.5	11
Grand Junc., Col.	12	11	5.5	12
Pueblo, Col.	10.5	9.5	5.5	10.5
Casper, Wyo.	11.5	10.5	5.5	12
Cheyenne, Wyo.	11	10	5.5	11.5
Billings, Mont.	12.5	11.5	6.5	12.5
Butte, Mont.	13.5	12.5	6.5	13.5
Great Falls, Mont.	12.5	11.5	6.5	12.5
Helena, Mont.	13	12	6.5	13
Salt Lake City, Utah	13.5	12.5	5.5	14.5
Boise, Ida.	14.1	13.1	6.5	16.5
Twin Falls, Ida.	15.6	14.6	6.5	17
Albuquerque, N. M.	10	9	*7	9.5
Roswell, N. M.	9.5	8.5	*7	9
Santa Fe, N. M.	10.5	9.5	*7.5	10
Ft. Smith, Ark.	9.5	9.25	*7	9.5
Texarkana, Ark.	9	8	*5.5	9
Muskogee, Okla.	9.5	8.5	7	8.5
Oklahoma City, Okla.	9.5	8.5	7	8.5
Tulsa, Okla.	9.5	8.5	7	8.5

*Taxes: In gasoline tax column are included these city taxes—Albuquerque, & Roswell, 0.5c Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.; Okla. 5.5c state applies within city limits of Ft. Smith, Ark.

†To consumers & Dealers.

S. O. NEB.

	(Regular Grade) T.W.	Dealer	Gasoline Taxes	Kerosine T.W.
Omaha	11.4	9.6	6.5	10.1
McCook	12.0	10.1	6.5	10.5
Norfolk	11.9	10.4	6.5	10.6
North Platte	12.3	10.6	6.5	11
Scottsbluff	12.9	10.2	6.5	10.5

S. O. CAL.

Standard Gasoline (*Regular Grade*)
Flight Gasoline (*Third Grade*)

	Standard Posted Net Tank Truck	Standard Posted Retail	Flight Posted Net Tank Truck	Flight Posted Retail	Gasoline Taxes
San Francisco, Cal.	10	14	9	12	4.5
Los Angeles, Cal.	9.5	13.5	8.5	11.5	4.5
Fresno, Cal.	11	15	10	13	4.5
Phoenix, Ariz.	12	16	10	13	6.5
Reno, Nev.	12	16	11	14	5.5
Portland, Ore.	10.5	14.5	9.5	12.5	6.5
Seattle, Wash.	10.5	14.5	9.5	12.5	6.5
Spokane, Wash.	12.5	16.5	11.5	14.5	6.5
Tacoma, Wash.	10.5	14.5	9.5	12.5	6.5

Std. Aviation 73

	Posted Net Tank Truck	Gasoline Taxes	Kerosine Tank Truck
San Francisco, Cal.	12.5	4.5	11.5
Los Angeles, Cal.	12	4.5	10
Fresno, Cal.	13.5	4.5	12.5
Phoenix, Ariz.	14.5	6.5	12.5
Reno, Nev.	14.5	5.5	13.5
Portland, Ore.	13	6.5	13.8
Seattle, Wash.	13	6.5	13.8
Spokane, Wash.	16	6.5	16.8
Tacoma, Wash.	13	6.5	13.8

Resale & Commercial: T.C. deliveries 0.23c per gal. off posted net tank truck.

Commercial: Retail deliveries, and/or tank truck deliveries of less than 40 gals., 4c per gal. above posted net tank truck price for Standard Aviation and Standard Gasoline, and 3c per gal. above posted net tank truck for Flight Gasoline, except single deliveries of less than 40 gals. to Marine trade only, which are billed at posted net tank truck price.

TEXAS CO.

	Gasoline—Dealer T.W. Fire-Chief (Regular)	Indian (3rd Grade)	Gasoline Taxes
Dallas, Tex.	7.5	6.5	5.5
Ft. Worth, Tex.	7.5	6.5	5.5
Wichita Falls, Tex.	8.5	7.5	5.5
Amarillo, Tex.	8.5	7.5	5.5
Tyler, Tex.	8.5	7.5	5.5
El Paso, Tex.	11	10.5	5.5
San Angelo, Tex.	8.5	7.5	5.5
Waco, Tex.	8.5*	7*	5.5
Austin, Tex.	8.5	7.5	5.5
Houston, Tex.	8.5	7.5	5.5
San Antonio, Tex.	8.5	7.5	5.5
Port Arthur, Tex.	8.5	7.5	5.5

*Less 1c temporary allowance to all dealers.

(Continued on next page)

Tank Wagon Prices (Continued)

S. O. IND.

Red Crown (*Regular Grade*)
Blue Crown (*Third Grade*)
Red Dealer Prices

	Crown Cons. T.W.	Red Crown	Blue Crown	Gaso- line Taxes	Kero- sine T.W.
Chicago, Ill.	11.6	9.6	9.1	4.5	10.6
Decatur, Ill.	11.6	9.6	8.7	4.5	10.3
Joliet, Ill.	11.9	10.3	9.2	4.5	10.4
Peoria, Ill.	11.7	9.9	9.7	4.5	10.4
Indianapolis, Ind.	11.6	10.1	9.6	5.5	10.1
Evansville, Ind.	11.4	9.9	8.6	5.5	9.9
South Bend, Ind.	12	10.5	10	5.5	10.5
Detroit, Mich.	11.4	9.9	9.4	4.5	10
Grand Rapids, Mich.	11.4	9.9	9.4	4.5	9.9
Saginaw, Mich.	11.4	9.9	9.4	4.5	9.9
Green Bay, Wis.	12.2	10.7	10.2	5.5	10.9
Milwaukee, Wis.	12.1	10.6	10.1	5.5	10.8
La Crosse, Wis.	11.9	10.4	9.9	5.5	10.6
Minneapolis - St. Paul	11.9	10.4	9.9	5.5	10.6
Duluth, Minn.	12.2	10.7	10.2	5.5	10.9
Mankato, Minn.	11.9	10.4	9.9	5.5	10.6
Des Moines, Ia.	11.4	9.9	9.4	4.5	*10.1
Mason City, Ia.	11.7	10.2	9.7	4.5	*10.4
St. Louis, Mo.	11.0	9.5	9.3	*4.5	10.1
Kansas City, Mo.	11.0	9.5	8.6	*4.5	9.7
St. Joseph, Mo.	11.2	9.7	9.2	*4.5	9.9
Fargo, N. D.	12.9	11.4	10.9	5.5	11.6
Huron, S. D.	12.3	10.8	10.3	5.5	11
Wichita, Kans.	10.3	8.8	7.2	4.5	8.7

Stanavo Aviation 73 Octane

Chicago, Ill.	15.7	4.5
Milwaukee, Wis.	15.9	5.5
Minneapolis, Minn.	15.7	5.5
St. Louis, Mo.	15.2	*4.5
Kansas City, Mo.	14.8	*4.5
Fargo, N. D.	16.7	5.5
Huron, S. D.	16.1	5.5

(Prices are base prices before discounts)

	Oleum Spirits	V.M.&P. Naphtha	Stani-sol	*Taxes
Chicago	13.5	13.8	12.8	4.5
Detroit	15.8	15	16.3	4.5
K. C., Mo.	13.3	14.3	13.8	3.5
St. Louis, Mo.	13.7	14.7	13.2	3.5
Milwaukee	14.4	15.4	14.9	5.5
Minneap'lis	14.2	15.2	13.5	5.5

Fuel Oils T.W.
Chicago

	Standard Heater Oil
1-99 gals.	9.3
100-149 gals.	8.3
150 gals. & over	7.8

	Stanolex Fuel Oil No. 1	Stanolex Furnace Oil
1-99 gals.	8.8	8.8
100-149 gals.	7.8	7.8
150-399 gals.	7.8	7.8
400 gals. & over	7.3	7.3

	Stanolex Fuel Oil A	Stanolex Fuel Oil B
1-99 gals.	8.3	8.3
100-399 gals.	7.3	7.3
400-749 gals.	6.3	6.3
750 gals. & over	5.55	5.55

Stanolex Bunker C Fuel Oil

1-399 gals.	6.8
400-999 gals.	5.8
1000 gals. & over	4.8

Other Points Indianapolis	Stanolex Furnace Oil
1-99 gals.	9.0
100 gals. & over	8.0
Detroit	
1-99 gals.	8.7
100 gals. & over	7.7
Milwaukee	
1-99 gals.	9.0
100 gals. & over	8.0
Minneapolis	
1-99 gals.	9.1
100 gals. & over	8.1
St. Louis	
1-99 gals.	8.1
100 gals. & over	7.1
Kansas City	
1-99 gals.	8.1
100 gals. & over	7.1

*Taxes: In gasoline tax column are included these city taxes—Kansas City, St. Joseph and St. Louis, 1c. Iowa kerosine prices are ex 3c state tax. In naphtha tax column are included 1.5c federal tax and state taxes.

State sales, occupation, consumer and use taxes to be added when applicable.

HUMBLE OIL

Humble Motor Fuel (*Regular Grade*)
Thriftane (*Third Grade*)

	Humble *Tank Wagon	Humble Re-tail	Thriftane *Tank Wagon	Thriftane Re-tail	Gaso-line Taxes
Dallas, Tex.	7.5	10.5	6.5	10.5	5.5
Ft. Worth, Tex.	6.5	9.5	6	7.5	5.5
Houston, Tex.	8.5	12.5	7.5	10.5	5.5
San Ant., Tex.	8.5	12.5	7.5	10.5	5.5

	Kerosine *Tank Wagon	Kerosine Retail
Dallas, Tex.	7	10
Ft. Worth, Tex.	7	11
Houston, Tex.	8	11
San Antonio, Tex.	7	10

73 Oct. Aviation Gasoline	Tank Car
FOB Baytown, Tex.	8.5

*To all classes of dealers & consumers.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals. are 0.5c higher. Cleveland Division assumed the state-wide fuel oil tank wagon prices on Nos. 1, 2 and 3 fuel oil, effective May 10. However the price of 7.55c per gallon and No. 4 fuel oil (full compartment hose dumps only) will remain as heretofore, in Cleveland Division.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals., 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price, 50 to 249 gals., 0.5c; 250 to 499 gals., 1c; 500 gals. or over, 1.5c.

S. O. OHIO

*Sohio X-70 Gasoline (*Regular Grade*)

	Consumer T.W.	**Re-sellers	‡S.S. Taxes	Gaso-line Taxes	†Kero-sine T.W.
Ohio, Statewide	12	10	13.5	5.5	9.3
Akron	12	9.5	12.5	5.5	9.3
Cincinnati	12	9.5	12.5	5.5	9.3
Cleveland	12	9.5	12.5	5.5	9.3
Columbus	12	9.5	12.5	5.5	9.3
Dayton	12	9.5	12.5	5.5	9.3
Marietta	12	9.5	12.5	5.5	9.3
Portsmouth	12	9.5	12.5	5.5	9.3
Toledo	12	9.5	12.5	5.5	9.3
Youngstown	12	9.5	12.5	5.5	9.3

Aviation Gasoline—Statewide

	Consumer Gasoline T.W.	Taxes
Sohio aviation grade 65 octane, Spec. AN-VV-F-756	14.5	5.5
Esso Ethyl Aviation 73 Oct.	15.5	5.5
Esso Ethyl Aviation 80 Oct.	16.5	5.5
Esso Ethyl Aviation 87 Oct.	17.5	5.5
Esso Ethyl Aviation 91 Oct.	17.5	5.5
Esso Ethyl Aviation 100 Oct.	25.5	5.5

	†Naphtha—T.W. Statewide	Lucas County
S. R. Solvent	13.5	13.5
D. C. Naphtha	14.5	14.25
v.M.&P. Naphtha	14.5	14.25
Varnolene	14.5	14.25
Sohio Solvent	14.5	14.25

Fuel Oils—T.W.	No. 1	No. 2	No. 3	No. 4
Ohio, Statewide	8.3	8.3	7.8	7.55*

*Renown (third-grade) prices are same as X-70 unless otherwise noted.

**Except authorized agents.

†Kerosine prices are ex 1c state tax. Naphtha prices are ex 1.5c federal & 4c state tax.

‡Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

* For Cleveland area only.

Canada

PRICES OF IMPERIAL OIL, LTD.

Per Imperial Gallon, which is 1.2 U. S. Gallons

IMPERIAL OIL

3-Star Imperial Gasoline (*Regular Grade*)

	†Gasoline T.W.	*Gasoline Taxes	†Kero-sine T.W.
Hamilton, Ont.	17.5	11	18
Toronto, Ont.	17.5	11	18
Brandon, Man.	21	10	23
Winnipeg, Man.	20.5	10	22.5
Regina Sask.	18	10	20
Saskatoon, Sask.	20.8	10	22.8
Edmonton, Alta.	18.9	10	20.9
Calgary, Alta.	16	10	18
Vancouver, B. C.	15	10	24
Montreal, Que.	17	11	17.5
St. John, N. B.	16.5	13	19
Halifax, N. S.	16.5	13	19

*Includes 3c Federal, and Provincial taxes.
†To divided & undivided dealers.

ATLANTIC REFINING

Atlantic White Flash Gasoline (*Regular Grade*)

	Commercial T.W.	Dealer T.W.	Gaso-line Taxes	Kero-sine T.W.
Philadelphia, Pa.	10.2	10.7	5.5	12.25
Pittsburgh	10.7	11.2	5.5	12.6
Allentown	10.7	11.2	5.5	12.6
Erie	10.7	11.2	5.5	12.6
Scranton	10.7	11.2	5.5	12.6
Altoona	10.7	11.2	5.5	12.6
Emporium	10.7	11.2	5.5	12.6
Indiana	10.7	11.2	5.5	12.6
Uniontown	10.7	11.2	5.5	12.6
Harrisburg	10.7	11.2	5.5	12.6
Williamsport	10.7	11.2	5.5	12.6
Dover, Del.	....	11.2	5.5	12.6
Wilmington, Del.	....	10.7	5.5	12.1
Boston, Mass.	....	10.9	5.5	....
Springfield, Mass.	....	11.8	4.5	....
Worcester, Mass.	....	11.5	4.5	....
Fall River, Mass.	....	11	4.5	....
Hartford, Conn.	....	11.6	4.5	....
New Haven, Conn.	....	11	4.5	....
Providence, R. I.	....	11	4.5	....
Atlantic City, N. J.	....	10.7	4.5	10
Camden, N. J.	....	10.7	4.5	10
Trenton, N. J.	....	10.7	4.5	10
Annapolis, Md.	....	11.05	5.5	10.8
Baltimore, Md.	....	10.45	5.5	9.8
Hagerstown, Md.	....	11.55	5.5	10.3
Richmond, Va.	....	11.25	6.5	12.3
Wilmington, N. C.	11.55	7.5	11.9	....
Brunswick, Ga.	....	10.4	7.5	11.1
Jacksonville, Fla.	....	10.4	8.5	12.1

	Mineral Spirits T.W.†	V.M.X.P. T.W.†
Philadelphia, Pa.	11	12.5
Lancaster, Pa.	12	13.5
Pittsburgh, Pa.	12.5	13.5

Fuel Oils—T.W.

	1	2	3	5	6
Phila., Pa.	10.1	9	9	5.76	5.04*
Allentown, Pa.	10.6	9.3	9.3	....	....
Wilmington, Del.	10.1	9	9	....	....
Springfield, Mass.	10.2	9.4	9.4	....	....
Worcester, Mass.	10.2	9.3	9.3	....	....
Hartford, Conn.	10.5	9	9	....	....

‡Does not include 1c Georgia kerosine tax.
†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.

Discounts:

Gasoline—to undivided dealers, 0.5c off dealer t.w., except Georgia & Florida dealer t.w. and undivided dealer t.w. prices are same.

Kerosine—Thru Penna. & Delawa re, 2c off t.w. price on t.w. deliveries of 25 gals. or more at one time.

*Residual fuel 13.0-15.9 gravity effective 10/17/43.

S. O. KY.

Crown Gasoline (*Regular*)
Standard (*Third Grade*)

	†Net Crown	Dealer Standard	Gaso-line Taxes	Kero-sine T.W.
Covington, Ky.	9.5	...	6.5	9.3
Lexington, Ky.	10.5	8.5	6.5	9.3
Louisville, Ky.	10	...	6.5	8.8
Paducah, Ky.	10	8	6.5	8.8
Jackson, Miss.	10	9	7.5	*9
Vicksburg, Miss.	9.5	...	7.5	*8.5
Birmingham, Ala.	10	9	*8.5	9
Mobile, Ala.	9	...	*9.5	8.5
Montgomery, Ala.	10	9	*9.5	10
Atlanta, Ga.	11.4	...	7.5	*12.1
Augusta, Ga.	11.4	...	7.5	*11.6
Macon, Ga.	11.4	...	7.5	12.1
Savannah, Ga.	10.4	...	7.5	11.1
Jacksonville, Fla.	10.4	...	8.5	10.1
Miami, Fla.	10.4	...	8.5	10.1
Pensacola, Fla.	9	8	*9.5	8
Tampa, Fla.	10.4	...	8.5	10.1

*Taxes: In tax column are included these city and county gasoline taxes: Mobile, 2c city; Birmingham, 1c city; Montgomery, 1c city and 1c county; Pensacola, 1c city. Georgia and Montgomery, Ala. have 1c kerosine tax, Mississippi 0.5c, not included in above prices.
†Consumer t.w. prices are same as net dealer prices.

S. O. LA.

Esso Gasoline (*Regular Grade*)

	Consumer Tank Wagon	Dealer T.W.	Gaso-line Taxes	Kero-sine T.W.
New Orleans, La.	8.75	9.25	8.5	*9
Baton Rouge, La.	8.75	9.25	8.5	*9.5
Alexandria, La.	8.75	9.25	8.5	*9.5
Lafayette, La.	9	9.5	8.5	*9
Lake Charles, La.	9	9.5	8.5	*11
Shreveport, La.	8.5	9	8.5	*8
Knoxville, Tenn.	9.5	10	8.5	12.5
Memphis, Tenn.	8.90	9.40	8.5	10.5
Chattanooga, Tenn.	10.5	11	8.5	11
Nashville, Tenn.	10.5	11	8.5	10
Bristol, Tenn.	10.95	11.45	8.5	13.1
Little Rock, Ark.	9.5	10	8	10

*Louisiana kerosine prices are ex 1c state tax.
Discounts:

Esso Gasoline—To undivided dealers, 0.5c off dealer t.w.

(Continued on next page)

Seaboard Export Coastwise Prices

Atlantic Coast (Prices are of refiners, FOB their refineries & their tanker terminals, & of tanker terminal operators FOB their terminals)—Prices In Effect Nov. 29

District:	MOTOR GASOLINE 72 Oct. (ASTM)	68-70 Oct. (ASTM)	KEROSINE and/or NO. 1 FUEL	FUEL OILS No. 2	No. 3	No. 5	No. 6
N. Y. Harb.	9.2 - 9.4	9.2 (1)	7.1	6.7	6.7	$1.95-$2.01 (a)	$1.65 -$2.07
N. Y. Harb., barges	9.1 - 9.3	9.1 (1)	7	6.6	6.6	....	....
Albany	9.3 - 9.5	....	7.3	6.8	6.8 (2)	....	$1.85-$2.27 (1)
Philadelphia	9.2	....	7.2	6.7	6.7	$1.98	$1.65 -$2.07
Baltimore	8.95	8.85 (1)	7.2	6.7	6.7	....	$1.65 -$2.07
Norfolk	8.7	8.5 (1)	7.1	6.7	6.7 (1)	....	$1.65-$2.07 (2)
Wilmington, N. C.	8.7 - 8.75	8.5 (1)	7.05	6.7	....	....	....
Charleston	8.7 - 8.8	8.1 (1)	7.2	6.7 (2)	....	....	$1.60-$2.02 (2)
Savannah	8.25 - 8.4	....	7.05	....	....	....	$1.60-$2.02 (1)
Jacksonville	8.27 -8.4	....	7.05 (2)	6.25	....	....	$1.60-$2.02 (1)
Miami	8.27 (1)	....	7.05 (2)	....	....	....	....
Tampa	8.27 - 8.4	8.275 (1)	7.05	6.25 (2)	....	....	$1.50-$1.92 (2)
Pensacola	7 - 7.2 (1)	....	4.8 (1)	....	....	....	....
Mobile	7 - 7.2	....	4.75-5.05 (2)	....	....	....	....
New Orleans	6.125- 6.75	....	4.25 - 4.75	3.75 (2)	....	$1.27 (1)	$0.85-$1.27 (2)
Portland	9.5 - 9.65	....	7.3	6.8	6.8 (2)	....	$1.65-$2.07 (1)
Boston	9.4 - 9.7	9.7 (1)	7.2	6.7	6.7 (2)	$1.95-$2.07 (1)	$1.65-$2.07
Providence	9.4 - 9.7	....	7.2	6.7	6.7 (2)	$1.90 (1)	$1.65-$2.07

(a) This price is for a straight-run low pour test No. 5 fuel.

Tank Wagon Prices—Continued

SOCONY VACUUM

	Socony Mobilgas (Regular Grade) Com. Cons. T.W.	Indiv. Dlr. T.W.	Gasoline Taxes
New York City			
Manhattan & Bronx	10.1	10.6	*5.5
Kings & Queens	10.1	10.6	*5.5
Richmond	9.7	10.2	*5.5
Albany, N. Y.	9 9	10.4	5.5
Binghamton, N Y	11	11.5	5.5
Buffalo	10.2	10.7	5.5
Jamestown, N. Y.	10.4	10.9	5.5
Mt. Vernon, N. Y.	10.1	10.6	5.5
Plattsburg, N. Y.	11	11.5	5.5
Rochester, N. Y.	10.8	11.3	5.5
Syracuse, N. Y.	10.5	11	4.5
Bridgeport, Conn	10	10.5	4.5
Danbury, Conn	10.5	11	4.5
Hartford, Conn	10.6	11.1	4.5
New Haven, Conn	10	10.5	4.5
Bangor, Me	10.7	11.2	5.5
Portland, Me.	10.3	10.8	5.5
Boston, Mass.	9.9	10.4	4.5
Concord, N. H.	11.4	11.9	5.5
Lancaster, N. H	12	12.5	5.5
Manchester, N. H.	11.3	11.8	5.5
Providence, R. I.	10	10.5	4.5
Burlington, Vt.	10.9	11.4	5.5
Rutland, Vt.	11	11.5	5.5

	Mineral Spirits T.W.	V.M.&P. T.W.
Buffalo, N. Y.	12.4	13.6
New York City	11	12
Rochester, N. Y.	13.2	14.4
Syracuse, N. Y.	14	....
Boston, Mass.	12	13
Bridgeport, Conn	†16.3	†17.3
Hartford, Conn.	†16.3	†17.3
Providence, R. I.	13	14

	Kerosine Yard	Kerosine T.W.	Mobilfuel Diesel T.C.	Mobilfuel Diesel T.W.	Mobilheat Fuel Yard	Mobilheat Fuel T.W.
New York:						
Manhat'n & Bronx	7.5	10.3	...	9.3	7.1	9
Kings & Queens	7.5	10.3	...	9.3	7.1	9
Richmond	7.5	10.3	...	...	7.1	8.8
Albany	7.5	9.8	7	9.3	7	9
Binghamton	8.9	11.2	...	10.7	8.4	10.2
Buffalo	8.6	10.9	8	10.3	8.2	10
Jamestown	8.7	11	...	10.6	8.3	10
Mt. Vernon	7.6	10.3	...	9.4	7.2	9
Plattsburg	8.1	10.4	...	9.9	7.6	9.4
Rochester	8.7	11	7.9	10.2	7.9	9.7
Syracuse	8.5	10.8	7.8	10.1	7.8	9.6
Conn.:						
Bridgeport	7.8	10.3	...	....	7.2	8.8
Danbury	8.2	10.8	...	...	7.5	8.8
Hartford	8.0	10.5	...	9.5	7.2	9
New Haven	7.8	10.3	...	9.3	7	8.9
Maine:						
Bangor	7.9	10.2	7.4	9.7	7.4	9.1
Portland	7.5	10.2	7	9.3	7	9
Mass.:						
Boston	7.8	10.6	6.9	9.2	7.1	9
N. H.:						
Concord	8.4	10.7	...	....	8.2	10
Lancaster	9.5	11.8	...	....	9.2	11
Manchester	8.5	11.1	...	....	7.9	9.7
R. I.:						
Providence	7.6	9.9	6.9	9.2	7.1	8.9
Vermont:						
Burlington	8.1	10.4	7.5	9.8	7.5	9.2
Rutland	8.3	10.6	...	10	7.7	9.5

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).

†In steel barrels.

Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

	Bunker C Fuel Ships' bunkers (Ex Lighterage)	Diesel Oil Ships' bunkers (Ex Lighterage)	Diesel Oil Shore Plants	Gas House Gas Oil 28-34 Gravity
N. Y. Harbor	$1.65-$1.77	$2.78	6.7-6.8 (2)	6.8 (2)
Albany	$1.85 (1)	$2.98 (1)	7 (1)	6.7
Philadelphia	$1.65-$2.07	$2.78	....	....
Baltimore	$1.65-$2.07	$2.78	6.7 (1)	6.7 (1)
Norfolk	$1.65-$2.07	$2.78	6.7 (1)	6.7 (1)
Charleston	$1.60-$2.02	$2.78 (2)	6.7 (1)	6.7 (1)
Savannah	$1.60-$1.77 (1)	$2.62 (1)	....	....
Jacksonville	$1.60-$2.02 (2)	$2.62 (2)	....	....
Tampa	$1.50-$1.92	$2.62 (2)	....	....
New Orleans	$0.97-$1.09	$1.65 (1)	4 (1)	....
Portland	$1.65-$1.77(1)	$2.86 (1)	7 (1)	6.9 (1)
Boston	$1.65-$1.77	$2.78	6 7 (2)	6.8 (2)
Providence	$1.65-$2.07	$2.78 (2)	6 9 (1)	6.8 (1)

Residual fuel prices generally vary with A.P.I. specifications from range low for 9.9 & below degrees to range high for 25.0 & above.

Gulf Coast

Prices in Effect Nov. 29

MOTOR GASOLINE	New Orleans & Lower Mississippi to Baton Rouge Tank Cars	New Orleans & Lower Mississippi to Baton Rouge Barge	Texas Gulf Coast South of New Orleans Tank Cars	Texas Gulf Coast South of New Orleans Barges	CARGOES Domestic & Export From all Gulf Ports
Leaded (oct. by ASTM)					
76 oct.	6.75	6.5 - 6.75	6.75	6.75	6.25 - 6.75
72 oct.	6.125	5.75	5.75	5.75	5.75
63-65 oct.	....	....	....	....	....
Unleaded 70 oct.	....	....	....	....	5.625- 5.75
67-68 oct.	....	....	....	....	5.5 - 5.625
65 oct.	....	....	....	....	5.25
60 oct.	....	....	....	....	5
KEROSINE & LIGHT FUELS					
41-43 w.w. kero.	4.125-4.25	4.125	4.125- 4.25	4.125	4.125
42-44 w.w. kero.	....	....	4.125	4.125	4.125
No. 2 fuel oil	3.75	3.75	3.75 - 4	3.75	3.75
DIESEL & GAS OILS					
(In diesel index No.)					
Below 43 di.	....	....	....	....	....
43-47 di.	....	....	....	....	4
48-52 di.	4	4	4	4	4
53-57 di.	4.125	4.125	4.125	4.125	4.125
58 and above	4.25	4.25	4.25	....	4.25

HEAVY FUELS & In Cargoes BUNKER OILS (At all Gulf Ports) Heavy Diesels	In Ship's Bunkers (Ex lighterage)
Below 28 API Grav.	$1 35
28 & above API Grav.	$1 65
Bunker Oil..... $0.85-$1.27	$0.85-$1.27

Above products in Truck Transports of 2,400 gal. and over ¼c above Tank Car Prices.

NOTE—Prices for heavy fuels vary within the range given above according to gravity from 9.9 B grav. and below to 25 B and above.

Mid-Continent Lubes

(At Gulf; in packages, FAS.; in bulk, FOB terminals)

Prices in Effect Nov. 29

	Steel Drums	Bulk
200 Vis. D 210 brt. stock	35 (1)	28.8 (1)
150 vis. D 210 brt. stock 0-10 p.p.	31 (1)	24.8 (1)
10-25 p.p.	....	....
100 vis. D 210 brt. stock 0-10 p.p.	....	....
10-25 p.p.	....	....
200 vis. No. 3 col. neutral: 0-10 p.p.	....	....

Wax

(Melting points are AMP, 3° higher than EMP. Prices are FOB refinery and do not include bag, freight or export differentials).

Prices In Effect Nov. 29

Crude Scale	New Orleans Export	N. Y. Domestic	N. Y. Export
124-6 Yellow	4.25(1)	....	4 25(1)
122-4 White	....	4.25(2)	4.25(2)
124-6 White	4.25(1)	4.25	4.25
Fully Refined:			
123-5	5.2(1)	5.2(2)	5.2(1)
125-7	5.2(1)	5.2(2)	5 2(1)
128-30	5.6(1)	5.6	5.6(1)
130-32	5.85(1)	5.85(2)	5.85(1)
133-5	6.15(1)	6 15	6 15(1)
135-7	6.4(1)	6.4(1)	6.4(1)

Naphtha

Prices In Effect Nov. 29

	V.M.&P. Naphtha	Mineral Spirits
New York Harbor	11 (2)	10
Philadelphia dist.	11 (2)	10
Baltimore	10.5 (2)	9.5
Boston	11.5 (2)	10.5
Providence	11.5 (1)	10.5 (2)

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ABOUT OIL PEOPLE

Mr. Pratt

Samuel F. Pratt has resigned as general secretary of the Pennsylvania Grade Crude Oil Assn., effective Jan. 1, to become vice-president of the Union Trading Co., 10 Rockefeller Plaza, New York City. Mr. Pratt has been connected with the Association since 1932 when he became a field service division representative. He was stationed in St. Louis and Philadelphia until 1935 when he was transferred to the home office in Oil City, Pa., as manager of the field service division. In 1936 he was sent to London as European manager and remained overseas until shortly after the outbreak of the war. Upon his return to the U. S. in the summer of 1939, Mr. Pratt was appointed assistant executive manager of the Association. Following the death of **J. E. Moorhead** in August, 1942, he was appointed general secretary, a post he held until his recent resignation.

° ° °

Frank Phillips, chairman of Phillips Petroleum Co., Bartlesville, Okla., added $70,000 to the Frank Phillips Foundation in commemoration of his 70th birthday on Nov. 28.

The Foundation, which devotes its funds to furthering youth movements such as Boy Scouts, Girl Scouts and scholarships for children of Phillips Petroleum Co. employes, and to scientific, religious and educational purposes, has been built entirely by contributions from personal funds of Mr. and Mrs. Frank Phillips. In addition to his regular contributions to the foundation, Mr. Phillips has made special gifts on his birthdays, matching his age in thousands of dollars.

° ° °

Heard at the fall Ohio Petroleum Assn. meeting at Columbus: **Harry Stensen,** Stensen Oil Co., Port Clinton, discussing vacations-in-Florida . . . Friends of **Jack Grant,** Quaker State, ribbing him about a 5-mile long tape worm, discovered as a result of "Doctor" Witherspoon's whiffle dust treatment. . . . **W. T. Holliday,** Ohio Standard's prez., arriving in the nick of time from New York via Cleveland, using planes, trains and taxis. . . . **Paul Ryan** thanking his many friends who wrote him nice letters during his extended illness. . . . . **Bob Warfel,** O.P.M.A. Exec. Sec'y., doing his usual good job of making everybody happy. . . . . Everyone wishing that **Sam Bohlen,** now overseas, hurries and finishes his job . . . . they all miss Sam.

Appointment of **Robert E. Hardwicke,** Ft. Worth, Tex., as associate chief counsel for PAW has been announced by Deputy PAW **Ralph K. Davies.** Mr. Hardwicke succeeds **Mortimer A. Kline,** now chief counsel for PRC. Before joining PAW as a special consultant in January of this year, Mr. Hardwicke was engaged in private practice as a member of the firm of Hardwicke and Cheek. Previously he had served on the legal staff of subsidiary companies of Gulf Oil Corp. in Houston, Ft. Worth and Wichita Falls, Tex., and in Venezuela. From 1936 until 1937 he lectured on petroleum economics at the University of Texas. He has written a number of books and articles on petroleum law.

° ° °

Raymond F. Nolan, for the past several years secretary to the manager of the asphalt sales department of the Texas Co., received New York University's Beta Gamma Sigma award to the night school student receiving the highest scholastic average for the work of his freshman year. Mr. Nolan entered New York University's School of Commerce last year to study industrial relations and labor economics.

° ° °

Five oil industry executives have been elected to membership in the Controllers Institute of America. They are: **Ernest C. Breeding,** assistant comptroller, the Texas Co., and **E. H. Mueller,** treasurer, Shell Pipe Line Corp., both of Houston, Tex.; **Ralph A. Cuthbertson,** general auditor, Cities Service Oil Co., New York, N. Y.; and **H. O. King** and **F. S. Slick,** comptroller and assistant comptroller, respectively, Ohio Oil Co., Findlay, Ohio.

° ° °

John M. Potter, Akron, a former Ohio Petroleum Marketing Assn. director, has been under treatment at the Pennsylvania Hospital in Philadelphia.

° ° °

Dr. Frank C. Croxton has been named supervisor of organic chemistry at the Battelle Memorial Institute in Columbus, Ohio. He was formerly associated with the Standard Oil Co. of Indiana.

° ° °

John Stevens, of the John Stevens Oil Co., Genoa, Ohio, has added to his business the distribution of blown rock wool for several Ohio counties.

° ° °

R. L. Davis now heads the alkylation department at Shell's Wood River refinery. He has been with Shell since 1932 and at the Wood River refinery since 1940, when he was made assistant head of the gas department. He held this post until his recent appointment.

J. R. Trolinger, Michigan state manager for Cities Service at Detroit has supplemented his meat rations with a 125 lb. buck, killed in the northern part of the state soon after the deer hunting season opened Nov. 15.

° ° °

E. R. Comer, secretary, joint tank car subcommittee, with an office at District 2 industry headquarters in Chicago, is due to report to Cornell University, Ithaca, N. Y., on Dec. 3, as a lieutenant, (jg) in the Navy. His training there will be for a 90-day-period. He was formerly with the transportation department of Phillips Petroleum Co. at Bartlesville. **G. P. Rada,** of transportation department, Deep Rock Oil Corp., Chicago, is filling the committee vacancy.

° ° °

R. E. Nelson has been made utilization supervisor for Stanolind Oil and Gas Co. at Tulsa under **G. B. Jenkinson, Jr.,** manager of the land department. Mr. Nelson formerly was assistant division land man at Fort Worth.

° ° °

Rodger R. Patton, subsurface geologist with Wilcox Oil and Gas Co. for the past three years, has resigned to organize a geological staff for Falcon Seaboard Drilling Co. at Tulsa.

° ° °

The American Institute of Mining and Metallurgical Engineers will be headed, in 1944, by **Chester Alan Fulton,** Baltimore, president of the Southern Phosphate Corp. Election was by letter ballot of 12,000 members. **Wallace E. Pratt,** New York, vice-president, Standard Oil Co. of New Jersey, and **John R. Suman,** Houston, vice-president in charge of production, Humble Oil & Refining Co., were included in the 6 directors elected. Mr. Fulton becomes the 61st president in the 72 years of the institute's existence. He will be formally inducted at the annual meeting in New York City next February.

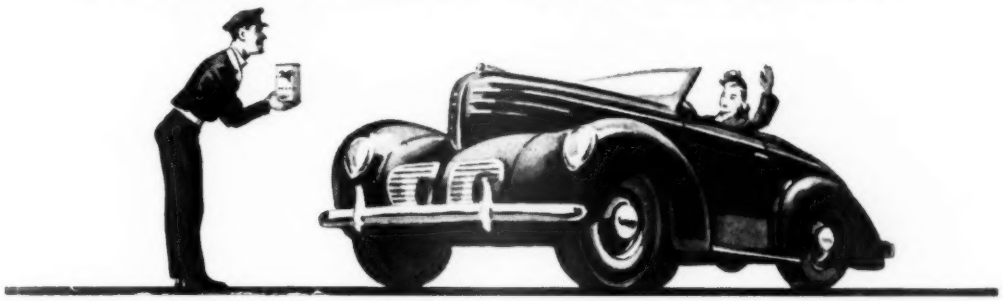
° ° °

Next week there will be another all-gal aggregation of Lazybench items; poems, jokes and bits of this, that and 'tuther submitted by oil lady readers of NPN.

If you haven't submitted something, do it now. If you have sent one and it hasn't appeared, don't become impatient. Chances are it will later and you will get either a box of candy for yourself, or a carton of cigarettes for your friend in the service.

Proved on the Fighting Front...

Proved on the Home Front...



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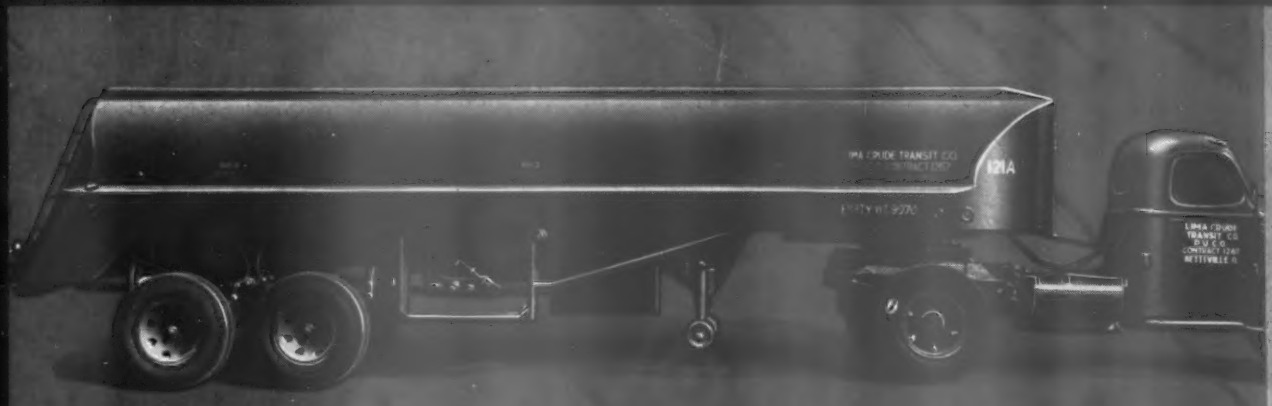

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NATIONAL PETROLEUM NEWS

Monthly Technical Section Devoted to
REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY

Section Two

December 1, 1943

Push the Thermal Crackers to Achieve Maximum Aviation Gasoline Output in Critical 6 Months!

High point of the refiners' meetings at the convention of the American Petroleum Institute in Chicago Nov. 9-11 was the urgent plea to operators of thermal cracking plants to push their units to increase yields of materials for the components of aviation gasoline.

By deeper cracking, the thermal units can provide almost immediately sufficient butylenes and isobutane to materially add to the supply of 100-octane aviation gasoline during the next few months, when it will be critically needed, Robert B. Cragin, Washington, Assistant Director of the PAW Refining Division, told the refiners present. In order that the thermal units may crack safely under more severe conditions, a method has been developed for calculating the safe working life of cracking coil tubes. This method was described at the same A.P.I. meeting.

Because of the urgency of Mr. Cragin's message, NPN's editors asked him to prepare it to present on this page, to bring it before refiners with thermal cracking plants who were not present at the Chicago meeting. His statement is given below. In this issue, pp. R-555-562, is also published the method for estimating safe life for cracking coil tubes.

By Robert B. Cragin, PAW Refining Division

THE NEXT four to six months represent the most critical period in the 100-octane aviation gasoline program. If all available planes both in this country and on the fighting fronts are to be kept in the air, we must resort to extraordinary efforts to increase the production of fighting grade aviation gasoline and its components.

Recent surveys indicate that we have in our codimer and alkylation plants a surplus production capacity in excess of 25,000 barrels per day for fighting grade aviation gasoline, which can be utilized if the butylene and isobutane feed stocks can be made available. It is for this reason that the Petroleum Administration issued Directive 75, calling for the utilization of all C_4 fractions in aviation gasoline or synthetic rubber manufacture where the isobutane and butylene content is 20% or greater.

We feel that drastic thermal cracking by the means proposed represents an additional contribution to the supply of these fractions. During this critical period we must concentrate not only on the segregation and utilization of current production of butylenes and isobutane, but we must also exert all possible efforts to maximize production of recoverable butylenes and isobutane. Therefore, wherever facilities are available either to segregate a C_4 fraction and load it into tank cars, or to utilize a C_4 fraction directly in the manufacture of aviation gasoline components, the Petroleum Administration is prepared to take the necessary enabling steps. The Aviation Gasoline Reimbursement Plan, which has been approved by the Army, Navy, Defense Supplies Corp. and the Petroleum Administration, provides that, upon recommendation by the Petroleum Administration for War, losses incurred in maximizing production of aviation gasoline are reimbursable by Defense Supplies Corp.

In the case of incremental production of C_4 fractions at extraordinary costs, such reimbursement takes the form of negotiating a price with the Petroleum Administration at which manufacturers of 100-octane gasoline will purchase the material for utilization at their manufacturing plants.

In view of the urgent need for additional butylenes and isobutane in the immediate future, the Petroleum Administration is prepared to take into account in such price negotiation all extraordinary costs which may be encountered as a result of maximizing production through drastic thermal cracking. The Petroleum Administration is prepared to direct the distribution of this material to manufacturers of fighting grade aviation gasoline.

We trust that the entire oil industry to a man will get behind the program, "Maximum 100-Octane Gasoline for the Next Six Months".

Petroleum Technologists Have Made Grease Manufacturing a Science

Reports and discussions at annual meeting of the National Lubricating Grease Institute tell of improved product manufacture to meet exacting military requirements as well as specialized industrial needs. *(See pgs. R-585-R-599.)*

Above, W. H. Oldacre, Chicago, D. A. Stuart Oil Co., new president of the National Lubricating Grease Institute; G. W. Miller, Buffalo, Battenfeld Grease & Oil Corp., re-elected secretary, and C. B. Karns, Pittsburgh, Standard Oil Co. of Pennsylvania, an Institute director

Right, Technologists who presented papers at the N. L. G. I. meeting: H. L. Moir, Chicago, Pure Oil Co.; C. M. Larson, New York, Sinclair Refining Co.; F. L. Koethen, Buffalo, American Lubricants, Inc.

REFINERY MANAGEMENT *and*
PETROLEUM CHEMICAL TECHNOLOGY

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Cracking-Coil Tubes at War— THEY CAN TAKE IT!*

By P. J. Harrington**, M. S. Northup**, and C. O. Rhys, Sr.**

The accompanying article presents the method by which operators of thermal cracking plants may estimate the safe working life of their cracking coil tubes, as a basis for more severe operating conditions to increase yields of butylenes and isobutane. An immediate critical need exists for these products in aviation gasoline production. It is also suggested economic considerations in normal times may justify more severe conversion in thermal plants, in view of increased yields obtainable.

One oil company, as is described, has operated a tube and tank unit, installed in 1927, for more severe reforming since last April, without a tube failure.

M. S. Northup C. O. Rhys, Sr. P. J. Harrington

CRACKING, of both thermal and catalytic types, constitutes one of the most important basic operations in the production of aviation-gasoline components. Although the various catalytic-cracking units completed or under construction may be counted upon to make the greatest possible contribution to this production, the time and material availability elements clearly indicate that we must continue to look to existing thermal-cracking equipment for further additional olefins and aromatics. From such equipment must come the marginal aviation-gasoline components which will do much to determine how quickly this war is won and hence at what cost in loss of men.

In order to produce the maximum of aviation-component materials the average cracking coil must crack at high conversion and at high temperatures. The attainment of these conditions involves, in general, a reduction in operating pressure and, consequently, lower throughput. Daily production, therefore, is affected directly, and lower pressures and throughputs are to be avoided except insofar as they permit a net gain in daily output per coil. In general, it may be assumed that production is a function of severity of cracking in each given cracking furnace, as this part of the unit has been found most frequently to be the limiting factor.

The punishment which a cracking furnace can take is a function of many variables, but among these none is more important than the relation between severity of service and safe useful tube life. It is of this limited but important aspect of the whole picture that this paper proposes to treat.

Fundamental to any treatment of this problem is recognition of the fact that for any given tube there is no limiting tube metal temperature as such. Tubes may be fired lightly, and they should last almost indefinitely (neglecting for the moment internal-corrosion effects), or they may be fired so heavily as to last but an hour; in every case there is an immutable relation between service severity and useful life. The problem then resolves itself into: 1, the determination of the relation between severity and life; and, 2 the choice of a life dependent upon the urgency of our wartime need.

With regard to the first of these items let us assume that we are dealing first with a case where corrosion and scaling may be neglected, where the tube has had no previous service life, and where the heat density is relatively low. These assumptions are taken into account later in this paper. Bailey[1] develops f, the stress in simple tension which, at any temperature, will produce the creep rate which results from the combined hoop, axial, and radial stresses at the tube bore. As a creep rate corresponds to a rupture time, f can be defined also as the stress in simple tension which will produce rupture in the same time as the sum of the three stresses at the tube bore. The following relation may be derived from Bailey's figures after certain substitutions and evaluation of constants:

$$f=\frac{\left(\frac{2}{1.2^{n'}}\right)PK^{2/n'}}{K^{2/n'}-1} \qquad \ldots\ldots\ldots\ldots(1)$$

where K is the OD to ID ratio for the tube, P is the pressure within the tube, and n' is a function of heat density. For low heat densities n' may be taken as 2.

K is equivalent to $\frac{R}{R-T}$ where R is the outside tube radius and t is the tube wall thickness. By substitution:

$$f=\frac{RP}{1.2t} \qquad \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Thus, from tube dimensions and operating pressure, the equivalent simple tension stress may be calculated.

Several companies, including The Babcock and Wilcox Tube Co., The General Electric Co., and The Timken Roller Bearing Co., have published figures[2] on the relation between stress and time-for-rupture at various temperatures for the

*Presented before Division of Refining, American Petroleum Institute, Chicago, Nov. 9, 1943.

**Standard Oil Development Co., Elizabeth, N. J.

several metals commonly used for cracking-coil tubes. If, for a given metal, the logarithm of the stress applied is plotted against the logarithm of the time-for-rupture, a series of straight lines is obtained with a line for each temperature. Thus, $TF^N = C$, where T is the time for rupture and F is the stress which is associated with T. N and C are constants for a given material. At any given temperature one may then write:

$$TF^N = C = T'f^N, \text{ or } T' = T\left(\frac{F}{f}\right)^N \quad (3)$$

Here T' is the time for rupture corresponding to the stress f. In order to evaluate equation (3) to relate T' to f, one requires only the relation of T to F and the value of N for the material being studied. As a usual unit for convenient calculation is the stress-for-rupture in 100,000 hours or 11.4 years, T may be taken as 11.4. The data cited above may be used to derive the following values of N:

Material	N
Carbon steel	2.35
5% chromium 0.5% molybdenum steel	4.05
18% chromium 8% nickel steel	5.70*
2¼% chromium 1% molybdenum steel	7.25

*May also be used for 25% chromium 20% nickel steel.

It also might be pointed out that the rupture-stress formula $TF^N = C$ covers published estimates to only 100,000 hours. There is no evidence for very long lives; but, for the purpose of determining emergency cracking-coil tube life, no extrapolation is necessary. For a very short life; say 100 hours and less, the N values cited above may not apply, but it may be assumed that even under emergency conditions a tube life of less than 2 months will not ordinarily be considered.

The figures referred to above have been used to prepare Fig. 1, which relates F, the stress which will cause rupture in 100,000 hours, to temperature for the steels mentioned. Conservative values have been used when conflict in estimated stresses required a choice of values.

Calculation of Tube Life

As an example of the use of the method outlined for determining tube life, consider a carbon-steel 4-in.-OD tube of ¼-in. wall thickness operating at 200 psi oil pressure and 1200° F tube metal temperature.

From equation (2):

$$f = \frac{(2)(200)}{(1.2)(0.25)} = 1333$$

From equation (3):

$$T' = 11.4\left(\frac{F}{1333}\right)^{2.35}$$

From Fig. 1, at 1200 deg F:
F = 600

Or:

$$T' = 11.4\left(\frac{600}{1333}\right)^{2.35} = 1.75 \text{ years}$$

Thus, a new carbon-steel tube, lightly fired and free from corrosion and scaling, should not fail under the conditions given for 1.75 years. It is evident that if the emergency should be considered as justifying a tube life of, say 6 months, substitution will yield a new value for F; and reference to Fig. 1 will indicate a temperature, which in this case is 1288° F.

Effect of Metal Losses

In the derivation given it was assumed that no corrosion, oxidation, or other loss of metal was suffered by the tube during its life. If there is such a loss, in the expression $TF^N = C$, F varies with T and

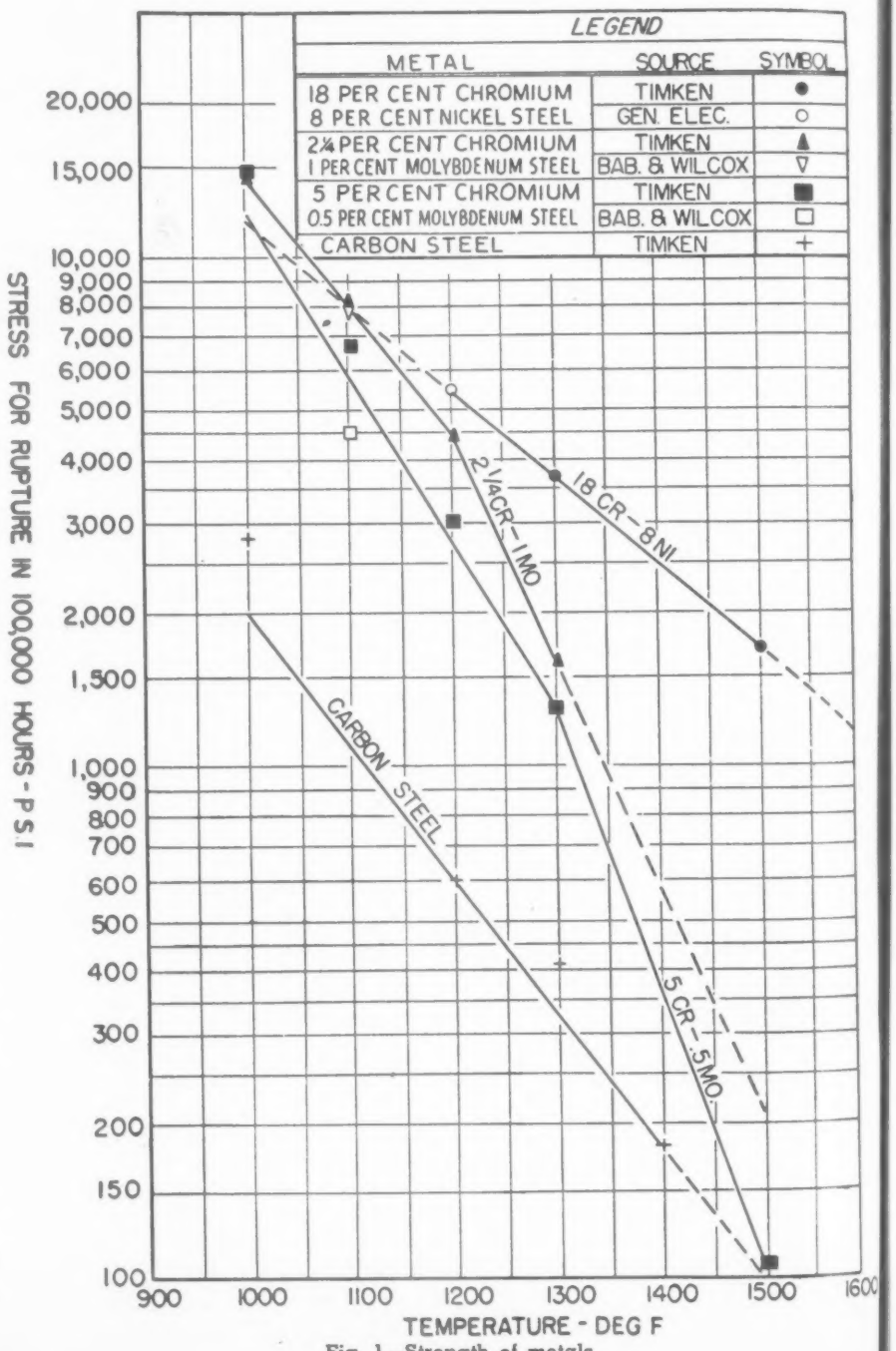


Fig. 1—Strength of metals

$$C=\int_o^T F^N dT \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

If t be the thickness at any instant and a the rate of loss of thickness:

$$a \cdot dT=-dt, \text{ or } dT=-\frac{dt}{a}$$

The stress can be taken as $\frac{RP}{1.2t}$, so that:

$$C=\frac{\left(\frac{RP}{1.2}\right)^N}{a}\int_{t_0}^{t_1} -t^{-N}\,dt \quad \ldots\ldots (5)$$

where t_1 is the final tube thickness at failure and t_0 is the initial tube thickness.

Performing the integration and putting in the limits:

$$C=\frac{\left(\frac{RP}{1.2}\right)^N\left(\frac{1}{t_1^{N-1}}-\frac{1}{t_0^{N-1}}\right)}{a(N-1)} \quad \ldots (6)$$

If F be taken as the rupture stress for 100,000 hours, $C=100{,}000\ F^N$. Also, if a be in inches per year, or $\frac{a}{8760}$ inches per hour, and if f be substituted for $\frac{RP}{1.2t_0}$, there results:

$$\left(\frac{t_0}{t_1}\right)^{N-1}=\frac{11.4a(N-1)\left(\frac{F}{f}\right)^N}{t_0}+1 \quad (7)$$

The tube life to rupture, or T' as used above, is $\frac{t_0-t_1}{a}$

As an example of the use of this variant of the life formula, assume that the tube in the example given above had been affected by corrosion and oxidation at a rate of 0.020 in. per year at 1200° F metal temperature. In this case, using equation (7):

$$\left(\frac{0.25}{t_1}\right)^{1.35}=\frac{(11.4)\,(0.02)\,(1.35)\left(\frac{600}{1333}\right)^{2.35}}{0.25}+1=1.19$$

Or:

$t_1=0.22$; and

$$T'=\frac{0.25-0.22}{0.02}=1.5 \text{ years}$$

Thus the rate of corrosion and oxidation assumed would have reduced the tube life from 1.75 years to 1.5 years.

Effect of Varying Service

The second initial assumption dealt with the use of new tubes. In considering existing cracking coils for more severe operations, account must be taken of the previous operating history of the tube. If a tube has operated for part of its useful life under one set of conditions and is to operate under a second set of conditions, the remaining life of the tube for the modified conditions is equal to the remaining estimated life under the first set of conditions multiplied by the ratio of the new tube life under the second set of conditions to the new tube life under the first set of conditions. This may be expressed:

$$L-s=(L_1-s)\frac{L_2}{L_1} \quad \ldots\ldots\ldots\ldots (8)$$

Where:

L = life with combined conditions.
s = service time under first conditions.
L_1 = life to rupture under first conditions alone.
L_2 = life to rupture under second conditions alone.

The derivation of equation (8) is quite involved, and will not be detailed here, but is available to anyone who wishes to study its validity. A series of applications may be necessary where a tube has undergone what might be called a "checkered career" but one on which suitable records are available.

As an example of the application of equation (8), assume that the 4-in. tube referred to above had been operated for 4.1 years at 1050° F without metal loss before use at 1200° F. What would the remaining life be at 1200° F on a corrosion-free basis?

L_1 can be found by using equation (3), as can L_2. These values, for 1050 and 1200° F are 14.1 years and 1.75 years, respectively, the latter being the same as calculated above for a new tube at 1200° F. Then:

$$L-s=(14.1-4.1)\frac{1.75}{14.1}=1.25 \text{ years}$$

With suitable allowances, several successive sets of past operating conditions (each with its proper metal-loss allowance, if any) can be studied to determine residual tube life for any proposed set of conditions.

It should be noted in passing that a very severe operation, such as would occur during a test or demonstration operation, can be tolerated for a short time without affecting too greatly the life of a tube subsequently returned to normal service. In the example cited, after 4.1 years at 1050° F, the tube could be run for a week's test at 1200° F and still have remaining 9.8 of its 10-year pretest life expectancy at 1050° F.

An interesting possibility for prolonging tube life is the heat treatment, without stress, of tubes whose useful life is partially spent. At least with the ferritic steels, it should be possible to reconstitute tubes by stress-free heat treatment at temperatures of the order of 1400 to 1700° F., provided the tubes have not been subjected to prior damage, such as the formation of intercrystalline cracks. Such damage would not be anticipated for a tube in normal use through the greater part of its life. Adequate experimental demonstration of this procedure (perhaps conducted in the furnace itself) is lacking, and it is felt that attempts at a restoration of this sort should be made by some laboratory equipped to do stress-rupture test work. With austenitic steels, such as 18-8, the procedure appears less likely to succeed (on purely theoretical grounds), but the necessity in the war emergency is less in this case. Comparatively few such tubes are available and, in general, they have greater useful equivalent life left for war uses than have the existing ferritic-steel tubes.

Effect of Heat Density on Tube Stress

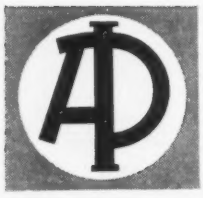
Another basic assumption made in the derivation given above dealt with tube heat densities. Bailey's n' depends upon tube materials, dimensions, and heat densities. With large-diameter thin-walled tubes, f is not greatly affected by changing heat densities; but, as tube size decreases and wall thickness increases, heat density more significantly affects f. Table 1 illustrates the effect of variations from an n' value of 2 as assumed above.

Table 1

Variation of f with tube dimensions and heat density (Tube is carbon steel. P = 200 psi for illustration)

Tube O.D. (Inches)	Tube-Wall Thickness (Inches)	Heat Density (Btu Per Hour Per Sq. Ft. of Outside Tube Surface)	True n'	True f
6	¼	0	6	1,930
6	¼	8,000	2	2,000
6	¼	50,000	0.43	2,320
3	½	0	6	440
3	½	15,000	2	500
3	½	50,000	0.76	650

The variation in n' for the various usual tube metals is very small, and safely may be neglected. Therefore, Table 1 has assumed carbon steel as a material. The percentage change in f with n' is independent of pressure, but a value of 200 psi has been used to make the f values specific. In the case of a large-diameter tube (6 in. OD) with thin walls (¼ in.), the error in f due to assuming $n'=2$ (and heat density = 8000 Btu per hour per square foot outside tube surface) is not great even when very high heat density is employed. If heat density is less than 8000, the true f is less than that calculated; and tube life calculated from the approximated value is less than the true tube life and, therefore, conservative. On the other hand, at a high heat density,



of say 50,000, the true f may be 16% greater than that calculated for the 3-in. tube and, hence, its use at first glance may appear unwise.

The small-diameter thick-walled tube has a true and calculated f of identical value when the heat density is 15,000 Btu per hour per square foot of outside tube surface. In this extreme case, as regards the dimensions of most commercial cracking coils, at a 50,000 heat density the calculated value of f is low by 30% and would be considered a quite unsafe value to use.

Effect of Heat Density on Metal Strength

However, before reaching a conclusion regarding the use of a general value of $n'=2$, another effect must be considered. In calculating F, the stress which will rupture the tube in 100,000 hours, the temperature to be used is taken as the outside tube metal temperature. This is a matter of convenience, as thermocouples for tube metal temperature measurement usually are located to read this value. When heat density is zero, the inside and outside metal temperatures are the same, and the use of an outside temperature gives a value of F which refers to the inside metal temperature where maximum stress occurs and where f is calculated. But we have seen that when heat flow is zero, the calculated f value is conservative for estimating tube life. When the heat density equals the value corresponding to $n'=2$ (8000 and 15,000 for the tubes of Table 1), f as calculated is no longer conservative, but equal to the real value. However, the flow of heat through the tube wall has set up a temperature gradient so that the metal at the bore is cooler and, therefore, stronger than the assumed strength value based on outside metal temperature.

As an example, consider the 3-in. tube with ½-in. walls, made of carbon steel and subjected to a 15,000 heat density with 1350°F. outside tube metal temperature. The calculated and actual stress, f, is 500 psi. At 1350°F. the rupture stress for 100,000 hours (F value) from Fig. 1 is 240 psi. Tube life is calculated from equation (3) to be 2.0 years. From the conductivity of carbon steel, however, we calculate a temperature drop of 35°F. through the ½-in. tube wall at 15,000 heat density. The inside tube metal temperature is, therefore, only 1315°F., so that the true value to be used in equation (3) would be $F=300$ *psi.* The corresponding tube life is 3.4 years. In this manner it is seen that the method proposed is conservative as regards tube-life estimation.

Finally, take the case of a 50,000 heat density on the same 3-in. tube. Here, as noted above, f as calculated is 500 psi, whereas the true stress is 650 psi. But the temperature drop through the metal is now 115°F., giving an inside metal temperature of 1235°F., and a proper value of F of 480 psi where the method set up directs the use of the value of 240 psi as noted above. In reality, using correct f and F values, the tube will last 5.6 years; whereas by following the method of calculation outlined, a life of 2.0 years was predicted. It may be demonstrated by further examples that the factor of safety included by working with outside tube metal temperatures is much greater than the error involved in assuming moderate heat densities.

It should be noted in passing that, if the calculated rather than the true value of f is used in a high heat-density case with an F value based on the inside tube metal temperature, a misleading tube-life factor of safety will result. For the example cited above, a life of 10.3 years to failure would be estimated as compared with the 5.6-year value resulting from correct f and F values and the 2.0-year value as found by the method of estimation proposed in this paper.

Effect of Uneven Heat Input Around Tube

Some consideration now will be given to the effect of uneven heat input around the circumference of a given tube. The available data are few, and in some cases conflicting; therefore, only a qualitative analysis will be attempted. Inasmuch as it is common practice to install tube metal temperature thermocouples at a point on the tube in the plane which faces the source of radiant heat and which bisects the tube longitudinally, it will be assumed that the measured metal temperature does not vary as a disproportionate amount of heat is absorbed by the exposed side of the tube—the average heat density being unchanged. Due to turbulent oil flow through the tube and the equalizing effect of heat flow around the tube through the wall metal from the hot to the cooler portion, it generally has been assumed that the inside tube metal temperature does not vary with non-uniform circumferential heat input.

Consider the case of the 3-in. tube already discussed, with the heat density at 15,000 Btu per hour per sq. ft. of outside surface and inside and outside metal temperatures of 1315 and 1350°F., respectively, and with uniform heat input around the tube. We would expect non-uniform heating (but at the same average heat density) to give the same uniform inside tube metal temperature and the same average outside tube metal temperature as determined at a point close to the adjacent tube in a row of tubes on the wall or roof of a furnace. Under these conditions and with the thermocouple location as previously discussed, the true and calculated values of F would not be affected by the non-uniform heat input, and the calculated value of f would remain unchanged. Due to the variation of n' with heat density, however, the true value of f at the point of greatest heat input on the tube would increase. Although accurate data are lacking, it has been estimated that, at average heat densities of 15,000, the maximum outside metal temperature variation of a cracking-coil tube is about 50°F. With an average metal drop for uniform heating as noted above of 35°F., the maximum heat input for non-uniform heating should be about 25,000 Btu per hour per sq. ft. of outside surface. This would increase the true f to 550 psi. On the other hand, the use of the average outside tube metal temperature of 1350°F. to determine F rather than the inside metal value of 1315°F. provides a factor of safety in F which greatly exceeds the effect, in terms of tube life, of the error in f due to nonuniformity. The calculated life of 2 years compares with a 2.75-year life, using $F=300$ at 1315°F. and $f=550$ at 25,000 heat density. The margin of safety noted above (3.4 years vs. 2.0 years) has been decreased by non-uniform heat input (to 2.75 years vs. 2 years), but is still ample.

If tube metal temperatures are taken at the high temperature point on the surface of an unevenly heated tube, the factor of safety is increased greatly, as the abnormally high temperature used would lead to a low calculated F value and a short calculated tube life. In the unlikely event that the lowest surface temperature is measured in the example cited, a surface temperature of about 1325°F. would result. The corresponding calculated F is 280 and, with a calculated f value of 500, the calculated tube life would be 2.9 years. Actually, due to bottom-of-the-tube conditions, the real life would be 2.75 years, as noted above. In this extreme case the formula fails to be conservative and, therefore, should not be used with cold-side measured tube metal temperatures.

Factor of Safety a Part of Method

The outlined method of estimating tube life, when applied with due allowance for the factors discussed above, should provide a safe working life as contrasted with the "tube life to rupture" to be developed by the more rigorous application of the theory involving the use of inside tube metal temperatures and allowances for actual tube stresses and heat densities. Therefore, it should be noted that no factor of safety nor other allowance to provide tube replacment before actual rupture is needed, because the subject method includes a factor of safety which adjusts itself to operating conditions.

It goes without saying that a multitude of outside factors also must influence decisions to remove tubes at or before the expiration of their safe working life. It is not unreasonable to set up a tube-replacement schedule based on less than the calculated safe working life when inexperienced firemen, very high pressures, small combustion space, limited draft and firing control, inadequate inspections between shutdowns, dependence of an en-

tire refinery on one cracking-coil furnace for production, small number or poor quality of tube metal thermocouples, or especially hazardous working conditions about the furnace dictate such a course. On the other hand, under favorable circumstances it is felt that full advantage should be taken of the relationship developed between severity of operation and tube life.

Importance of Tube Metal Temperatures

The one fundamental piece of information on which the method is dependent is the adequate determination of representative outside tube metal temperatures. It has been possible to develop quite satisfactory couple installations for this purpose; and, although the type of equipment and the installation and maintenance are beyond the scope of this discussion, information on this subject can be made available to anyone desiring it for use on war projects. A sufficient number of reliable couples must be maintained throughout the life of a tube if that life is to be satisfactorily obtained in actual service. In the absence of direct data, many efforts, based on both experience and theoretical considerations, have been made to estimate tube metal temperatures from oil temperature in the tube. These values are dependent on good oil temperatures, heat-density data, oil-film heat-transfer coefficients involving the high-temperature properties of bodies wherein two phases often occur, coking rates and coke-film heat-transfer coefficients, and similar factors which are so complicated as to make this type of estimate almost useless except in very special cases. This is particularly true when maximum tube service life under unusual conditions, with a minimum of failures, is of great importance, as is the case at the present time.

Design of New Equipment

In passing it should be pointed out that this paper is an adaptation of a method for designing new cracking-coil tubes for a desired life under expected operating conditions. For this approach the reader is referred to a report of the Standard Oil Development Co., which can be made available to any refiner having need for it in connection with a war project.

Relation to "Jersey" Experience

The method of estimating tube life given above has been, and is being tested further, by the experiences of companies associated with the Standard Oil Co. (New Jersey). It is too early for any conclusive evidence to be cited regarding the application of the formulas given, but it may be said that thus far no data at variance with the method outlined have been encountered. Table 2 lists some of the figures thus far available where the method is being tested.

Interpretation in Terms of Production

In order to try to translate the life-severity relation developed into terms of a typical war product, the hypothetical case of a heavy virgin naphtha reforming unit, charging 10,000 bbl. per day of feed in a once-through coil-only operation for the production of butenes, may be considered. Assume 18-8 tubes, 4.5 in. x 3.7 in. in diameter, operating at 1000 psi and with limiting allowable outside tube metal temperatures of 1200°F., a usual maximum value. Experience has shown that such a coil should produce 950 bbl. per day butenes for polymerization or alkylation, or even for butadiene manufacture for synthetic rubber. This assumes that the operation is limited entirely by allowable metal temperature resulting from high oil-cracking temperature even at moderate heat inputs, and not by coking, firing, or recovery equipment. A life-to-rupture of 25 years is calculated by the formula given above, although the data do not justify such an extrapolation. Prior operation of a year or two in such service would not be important in considering more severe operating conditions, and short-time corrosion usually may be neglected in an 18-8 tube. If this tube is to be stressed to a safe working life of 3 years (when presumably war alloy demands will permit replacement if obsolescence has not by that time—through development of catalytic cracking—permitted shutdown), it develops that metal temperatures of 1300°F. at a pressure of 1000 psi, or 1540°F. at a pressure of 400 psi, are permissible. It will be assumed that burner capacity, draft limitations, charge-pump size, product-recovery equipment, etc., are not limiting. From a tube-metal-limitation point of view, it is estimated that 1100 bbl. per day of butenes could be produced at a pressure of 1000 psi, or 1335 bbl. per day at a pressure of 400 psi. This 15.8- to 40.5% increase in production may not all be realized due to factors of the type cited above, but its potentialities should not be neglected.

A Second Example

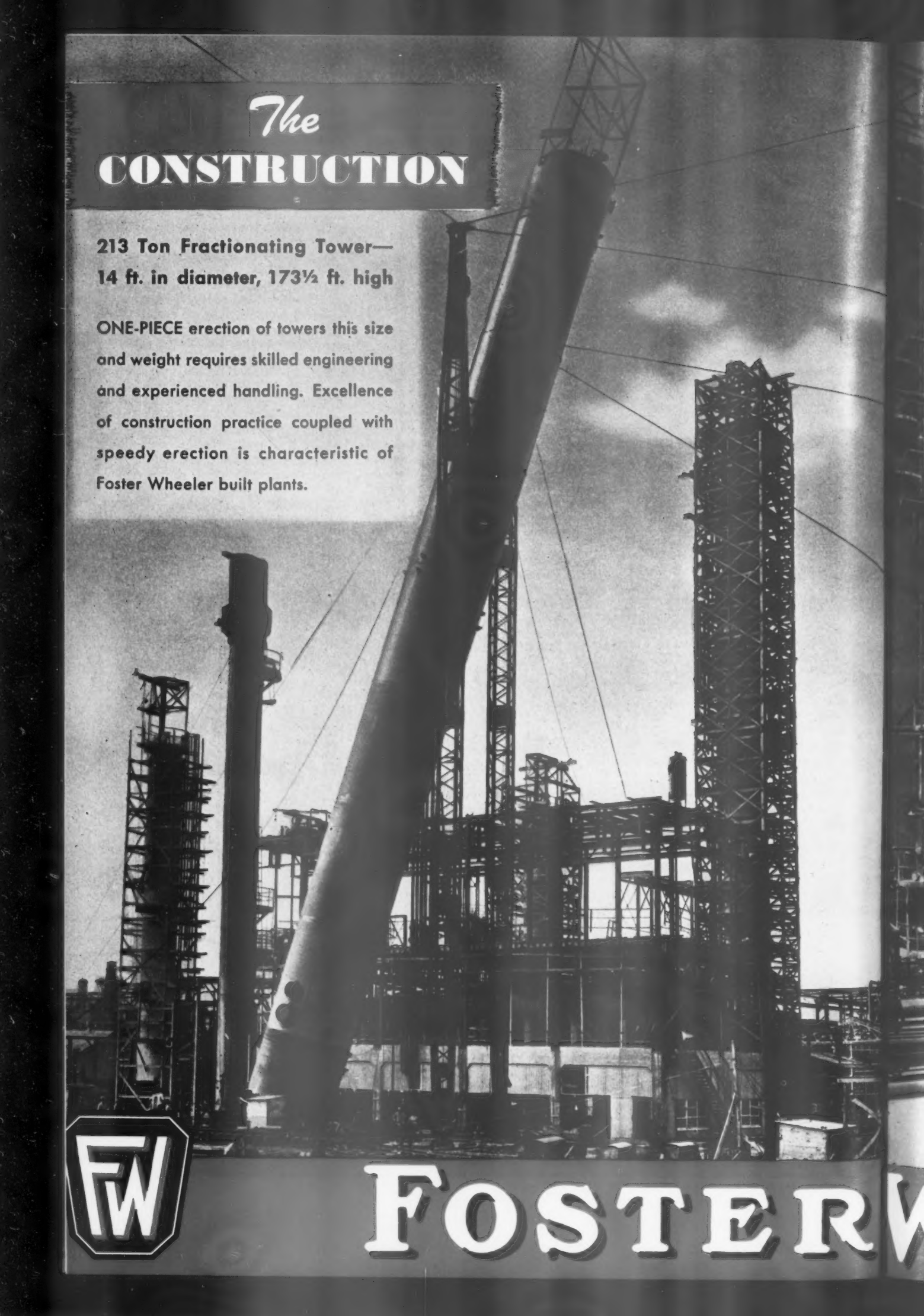
A second example involves a light gas-oil coil of 13,800-bbl.-per-day furnace or total feed capacity with 4-in. x 3-in. carbon-steel tubes, operating at present at a pressure of 300 psi and at a limiting metal temperature of 1100°F., to produce 260 bbl. per day of butenes. It may be calculated that if a one-year tube life, on the equivalent of new corrosion-free tubes, will tide over the emergency, the limiting metal temperatures may go to 1285 and 1400°F. at pressures of 300 psi and 150 psi, respectively. Estimates of butenes productions are 290 bbl. per day and 330 bbl. per day for the conditions given in the order listed, or increases in production of 11.5 and 26.9% respectively.

From these approximate figures, the great potential value of more severe

Table 2—Operations Designed To Compare Predicted and Actual Cracking-Coil Tube Life as a Function of Operating Conditions

Unit	Material	Tube Size (Inches)	Operating Pressure (PSI)	Operating Outside Tube Metal Temp. (Deg. F.)	Service Life to Date (Years)	Calculated Life (Years)	Estimated Remaining Life-Years
A	5% chrome-molybdenum	4½ x 3¼	750	1,200	3.3	4.5	1.2
B	5% chrome-molybdenum	4½ x 3¼	750	1,225	3.0	4.1	1.1
C	5% chrome-molybdenum	4½ x 3¼	550	1,195	2.3	4.5	2.2
D	18-8	4½ x 4	40	1,570	2.0	11.4+	9.4+
E	18-8	4½ x 4	50	1,470	0.9	11.4+	10.5+
F	18-8	4½ x 3.7	1,000	1,200	6.8	11.4+	
			25	1,600	0.1	11.4+	
					—		
					6.9		4.6+
G	Carbon steel	4½ x 3⅜	750	1,000-1,100	1.0	3.1	
			50	1,480-1,580	0.1	1.9	
					—		
					1.1		1.3

A = corrosion of 0.055 in. per year allowed.
B = corrosion of 0.060 in. per year allowed.
C = corrosion of 0.100 in. per year allowed.
F = two successive services are listed. The calculated life shown in each case is that of new tube life at the given service. The remaining life figure, however, is that left at the end of 6.9 years of combined service if the tube continues in the second service.
Where 11.4+ is used, the indicated life was above this value, the limiting life for which figures are available. The net life after service in this case is also greater than the given value to an unknown degree.
Where a range of service conditions is listed for a given period, coking or other causes led to variations in a steady manner for each run, and this variation has been taken into consideration in the calculations.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CONSTRUCTION
213 Ton Fractionating Tower—
14 ft. in diameter, 173½ ft. high
ONE-PIECE erection of towers this size and weight requires skilled engineering and experienced handling. Excellence of construction practice coupled with speedy erection is characteristic of Foster Wheeler built plants.
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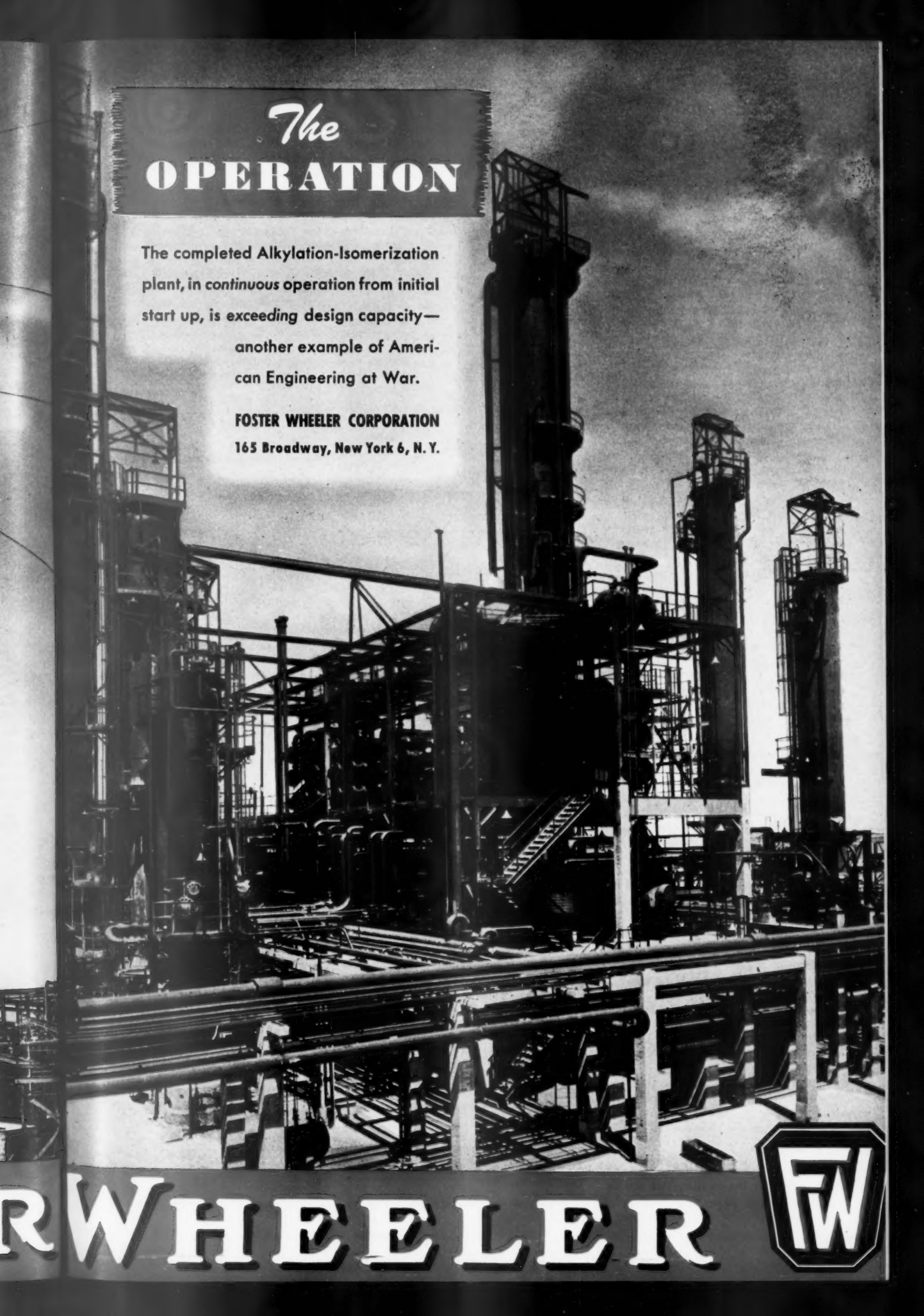
The
OPERATION
The completed Alkylation-Isomerization plant, in *continuous* operation from initial start up, is *exceeding* design capacity—another example of American Engineering at War.
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racking conditions during the present critical period of the war may be seen. As to the tubes, it is felt that, literally, they can "take it."

With present-day and possibly greater future interest in severe cracking operations at high temperatures, but at pressures from only a few pounds gage to 50 psi, a little conjecture on tube strengths may not be out of order. As noted in Fig. 1, the metal-strength data do not extend beyond 1300 to 1500°F., depending on the type of tube. Extrapolation to any considerable extent is most hazardous, both because of the uncertainty of the position and slope of the lines where the figures vary from a straight line to some extent, and because of the tendency of the metal strength to drop off abnormally at higher temperatures. This is evident in the 2¼% chromium 1% molybdenum and 5% chromium 0.5% molybdenum steels. (Due to the danger of air hardening, these alloys would probably be unsuitable for extremely high temperatures.) Some abnormal drop in strength must occur if the semi-log relation is to be consistent with the zero value of the metal strength at its melting point. Furthermore, the $TF^N = C$ relation cannot be used beyond the temperature range of the data upon which it is based. Having these limitations in mind, however, the N values given above may be used, and the lines of Fig. 1 extrapolated to temperatures of 2200 or 2300°F. for the F values needed to make short life calculations on existing tubes operating at very low pressures.

For instance, a 4.5-in. x 3.7-in. tube of 18-8 steel, at a pressure of 25 psi, to have a safe working life of 3 years without allowance for oxidation or corrosion might operate at 2250°F. Or a 4-in. x 3.2-in. carbon-steel tube, at the same pressure and protected from oxidation and corrosion and figured for a one-year safe life, could operate at 1660°F. Used tubes of this latter material and magnitude of dimension actually have been operated in this temperature and pressure region for one to two months without rupture, despite fairly rapid scaling.

In recent months a 4-in. carbon-steel tube, completely protected from oxidation and scaling, has been operated without failure from excessive pressure and temperature conditions for about 800 hours at a tube metal temperature of 2200°F., at a pressure of 15 psi, gage. The predicted life, on an extrapolated basis, ranges from a few hours to 1000 hours depending on the position and slope of the strength-temperature curve used, the value of N taken, and the method of calculation, i.e., for safe working life or for rupture. It should be noted that the metal temperature was taken on the surface nearest the radiant-heat source.

Earlier in this paper the problem of aviation-gasoline-component production from existing thermal cracking equipment was referred to as involving the determination of the relation between severity of service and tube life, and the choice of a life dependent upon the urgency of our wartime need. The severity-life relation has been discussed. The choice of an operating point now can be considered briefly, although this is largely an economic and patriotic problem. Under normal conditions cracking equipment should be operated at that degree of severity and corresponding tube life which results in an economic balance between the value (in terms of quantity and quality) of its products and the cost of maintenance and replacement. It is strictly a matter of tube-replacement cost (with due allowance for downtime, safety margin, etc.) and enhanced product value. There may be serious question raised as to whether the 5- to 15-year tube life so often resulting from relatively mild cracking conditions in many pre-war cracking operations represented the most economical operation of those coils. Tube replacements and their associated related costs probably represent only a small part of even a cracking coil, let alone a gasoline-producing unit; and yet the cracking furnace often has been the bottleneck of the production for the entire unit. Even with normal product prices and demands after the war, it may well behoove us to operate for one- to three-year tube lives when tube materials are readily available.

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Butylene Yield from Tube and Tank Unit Doubled by Deeper Cracking*

By E. B. McConnell

Chief of Refinery Process and Development Division, Manufacturing Department, Standard Oil Co. (Ohio)

THE paper presented by Mr. Harrington is of great importance to all refiners at this time, and should be reassuring to those who have hesitated to increase the severity of their cracking operations.

When my company started to produce codimer at one refinery, the yield of butylenes was very low. After obtaining through the Aviation Gasoline Advisory Committee the experience of the Standard Oil Co. of New Jersey, upon which Mr. Harrington's paper was based, we determined to increase our butylene production by going to severe reforming.

We selected a 750-pound tube and tank unit built in 1927, made a few changes in the flow through the furnace, and started to reform once through, coil only. The furnace contains 202 tubes, 4½-in. O.D., 23 ft. long. The tubes in the radiant section are a mixture of carbon steel, 2% chrome and 4-6% chrome. The header boxes are forged carbon steel. A series of three tests was run, charging a 61° A.P.I. crude naphtha, having a mid B.P. of 247, an E.P. of 404° F. and an ASTM octane number of 50, with the results shown in Table 1: Thus, by dropping the feed rate 31% and raising the coil outlet temperature 80° F., butylene production was increased by 195%.

This unit recently completed a 959-hour run during which the feed rate was 3600 BPSD, the coil outlet 1130° F., and the butylene yield about 5.8%, or 208 BPSD. The unit has operated under similar conditions since last April without a tube failure. We plan to raise the coil outlet temperature as soon as some bottlenecks in the light ends recovery equipment have been removed.

*Presented in discussion before the Refining Division, American Petroleum Institute, Chicago, Nov. 9, 1943.

Table 1—Results on Butylene Yield of More Severe Reforming

Test No.	1	2	3
Heat Fired—Million B.t.u./hr.	53.0	50.5	46.1
Coil Inlet Temp., °F.	286	263	256
Coil Inlet Press., psig	563	517	490
Coil Outlet Temp., °F.	1070	1150	1200
Coil Outlet Press., psig	175	195	195
Max. Tube Metal Temp., °F.	1308	1430	1445
Feed Rate, BPSD	5160	3570	3520
Yield Butylenes Vol. %	1.8	7.7	9.8
Production Butylenes, BPSD	93	275	345
Yield 10 lb. RVP Gasoline	97.0*	61.1	56.1
ASTM O. N. of 10 lb. Gasoline	61	75	76
CFR-R O. N. of 10 lb. Gasoline	63	86	88
Yield Dry Gas, Wt. %	6.9	29.6	31.3

*Includes 6% (on feed) of outside C_4 to make vapor pressure.

Recent Developments In Thermofor Catalytic Cracking Process*

By T. P. Simpson**, L. P. Evans**, C. V. Hornberg**, and J. W. Payne**

Recent improvements have been made in the equipment and processing technique employed in the Thermofor Catalytic Cracking process. The development and application of new types and forms of catalysts have influenced the design of both the reactors and regenerating systems. In addition, a number of newly developed devices have been applied to improve the operating characteristics of the equipment. These changes have resulted in simplification of design and better plant performance.

The principles of the TCC process and its operation were described before the American Petroleum Institute in November, 1942. Readers are referred to the Nov. 25, 1942, Technical Section of NATIONAL PETROLEUM NEWS, pg. R-427.

A. Catalysts

Clay Catalyst

THE catalyst now being used in commercial TCC units is produced from natural clays. The catalyst may be in the form of granules or pellets (Fig. 2) and, broadly speaking, covers sizes ranging from about 4- to 60-mesh. Improvements in manufacturing methods have resulted in the production of coarser and more rugged types of clay catalyst, and the materials now used commercially fall in the range of about 4- to 10-mesh size.

The use of clay catalysts offers certain advantages, including their availability in large quantities and relatively low cost. These are important considerations in the present emergency in view of the urgent need for large volumes of catalyst required to charge the various TCC units now being rushed to completion. These catalysts also are attractive for certain special applications, as in TCC operations conducted primarily for high butylene production.

Bead Catalyst

The general advantages of using the more active, though more expensive, synthetic-type catalysts in place of clay catalysts have long been recognized. Until recently, however, the available synthetic materials have not had suitable physical characteristics, notably with respect to attrition resistance, to justify their use in TCC units. This prompted Socony-Vacuum to undertake extensive research work on synthetic catalysts. The ultimate result of this work was the invention of a new material, known as the "bead" catalyst, which is unique in shape (see Fig. 2), and is outstanding with respect to both physical ruggedness and catalytic activity. This catalyst derives its name from the fact that it is produced in the form of small spherical particles resembling translucent glass beads.

The phenomenal ruggedness and resistance to attrition which this catalyst possesses can be demonstrated in many ways. An individual bead with a diameter of ⅛ in. will support an average load of about 200 lb., and a mass of beads in a column will support a load of about 3000 psi before crushing. In a jet test, where the beads are carried in an air stream at a velocity of 100 ft. per sec. and impinged against a vertical steel plate, they show no breakage and only 3% wear after passing through 90,000 cycles. We have not been able to find any cracking catalyst which approaches the beads in regard to either strength or resistance to wear.

The composition or method of manufacture of this catalyst cannot be disclosed at this time.

B. Equipment Modifications

Commercial TCC reactors were originally designed with an internal baffle system to provide high throughput capacity combined with efficient contact between oil vapors and catalyst. However, with this design the proportion of the total reactor volume occupied by the catalyst is reduced by the presence of the baffle system. Moreover, the quantity of the catalyst in the unit cannot be varied to provide maximum flexibility. Thus, although reactors of this type can be designed to operate at any specified space velocity, they cannot be operated below the designed space velocity without decreasing oil throughput rate. The first commercial TCC reactors being installed are of the baffled type, and will be operated on gas-oil cracking with clay catalyst which may later be changed, however, to the synthetic bead catalyst.

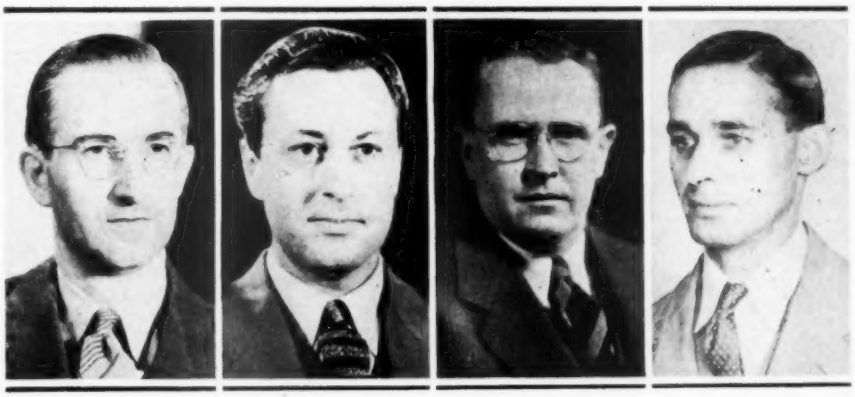
Recent catalyst developments have made it possible to design reactors of high throughput capacity which require no baffle system for obtaining intimate contact between oil vapors and catalyst. The elimination of internal baffling increases the effective volume of the reaction zone, and permits wide flexibility with respect to space velocity. All of the recent commercial TCC reactors are of this improved type. As an added feature of flexibility, the reactors can be adapted to either countercurrent or concurrent flow.

Catalyst Feed System

The catalyst feed system of present TCC units is designed to permit continuous flow of catalyst from the atmospheric part of the unit into the reactor, which operates at pressures up to 15 psi, gage. The system employed comprises a feed leg especially designed to provide maximum operating pressure for a minimum leg height.

Kilns

The thermofor kiln described in last year's paper[1] is typical of that used successfully in the reactivation of spent



C. V. Hornberg | L. P. Evans | T. P. Simpson | J. W. Payne

*Presented before Division of Refining, American Petroleum Institute, Chicago, Nov. 11, 1943.

**Socony-Vacuum Oil Co., Inc., Paulsboro, N. J.

fullers earth. This kiln is of the spiral finned-tube type employing a circulating molten - salt heat-transfer medium for temperature control.

The kilns in commercial TCC installations are of a radically different and simplified design. This new type of kiln is much cheaper to construct, more flexible in operation, and requires a minimum of alloy metals. Control of regeneration temperatures is excellent, and is achieved without recirculation of either flue gas or catalyst. The surplus heat developed in catalyst regeneration is utilized to produce high-pressure steam. The kiln operates at substantially atmospheric pressure, and requires only low-pressure blowers to supply the regeneration air. The atmospheric-pressure operation eliminates the necessity of employing a catalyst feed leg as is necessary in the reactor.

In order to secure a uniform contact between catalyst and vapors in TCC reactors and kilns, it is essential that the catalyst flow be uniform in all parts of the vessel. This has been achieved by means which also effect a convergence of the catalyst flow to one outlet point, thus permitting the use of a single draw-off pipe.

C. Products

The improvements in the TCC equipment and catalysts discussed hereinbefore have been paralleled by equally important developments in the application of TCC processing to the catalytic conversion of petroleum fractions. At present the TCC process is playing a vital role in the manufacture of high-octane aviation gasoline, of butylenes for the production of synthetic aviation blending agents and synthetic rubber, and of other essential war products. After the war TCC plants also will be utilized for the production of motor gasoline.

The application of the TCC process to the production of aviation-base stocks was discussed briefly in last year's paper.[1] The original processing scheme comprised TCC cracking of gas oils over clay catalyst followed by once-through TCC treating of the resulting motor gasolines. This operation yields aviation-base stocks having leaded (4 ml) octane ratings ranging from 94 to 97 (AFD °-1C) depending on the nature of the gas-oil charge stock. Moreover, the aviation-base stocks require little or no finishing treatment to meet gum, color, and sulfur specifications.

As a result of recent developments, substantial improvements have been made in the application of the TCC process for the production of aviation-gasoline-base stocks. Chief among these developments are:

a. The invention of the bead catalyst described previously herein.
b. The application of improved processing techniques in the treating step.
c. The extension of TCC processing to include a wide variety of charging stocks, other than gas oils, well suited for aviation production.

Bead catalyst is the most important of these developments, and makes possible significant gains in the manufacture of aviation-base stocks. With respect to the present aviation-fuel program the

°Aviation Fuels Division, CFR committee.

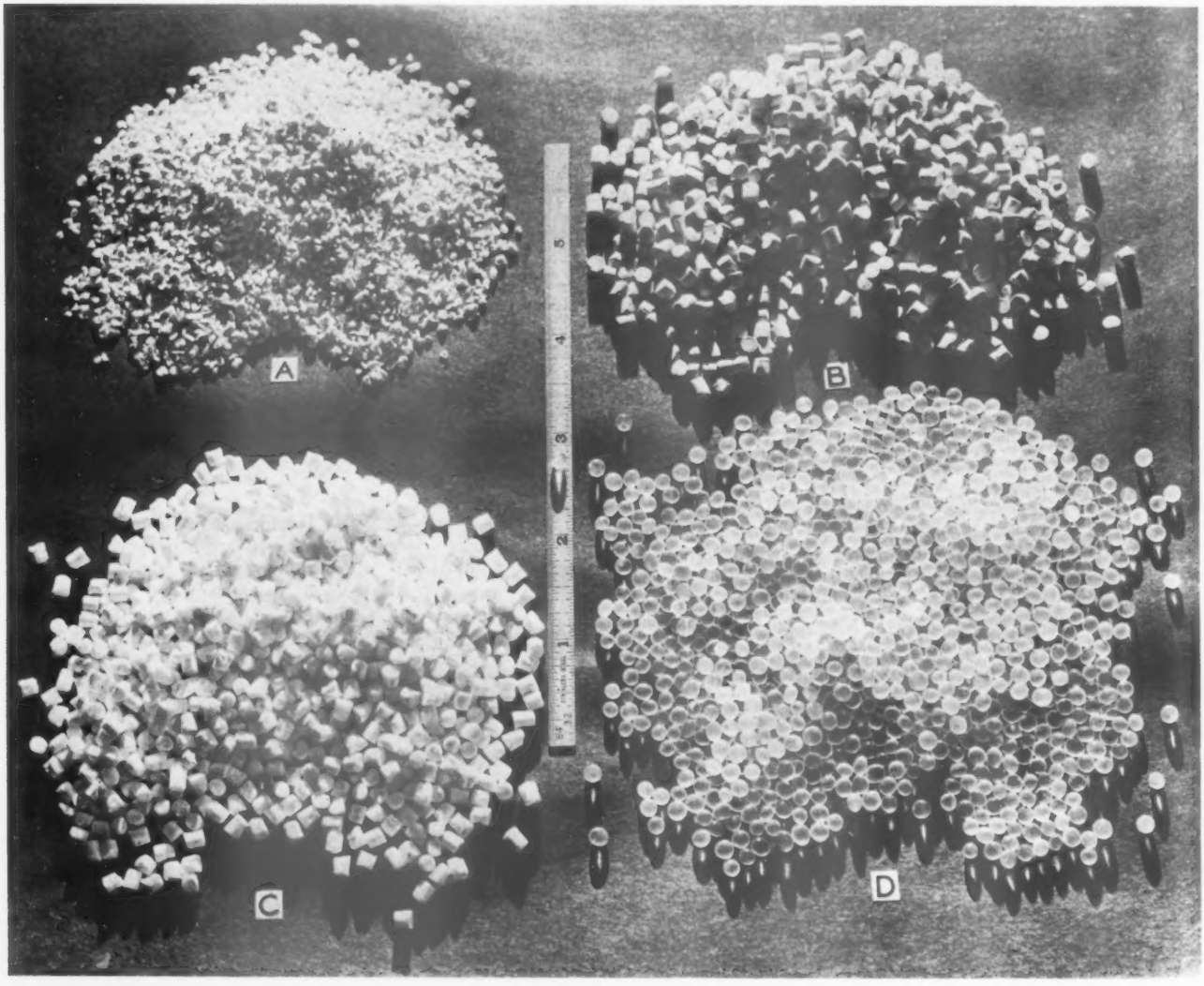


Fig. 2—Typical catalysts. A. Clay granules; B. Clay pellets; C. Synthetic pellets; D. Synthetic beads

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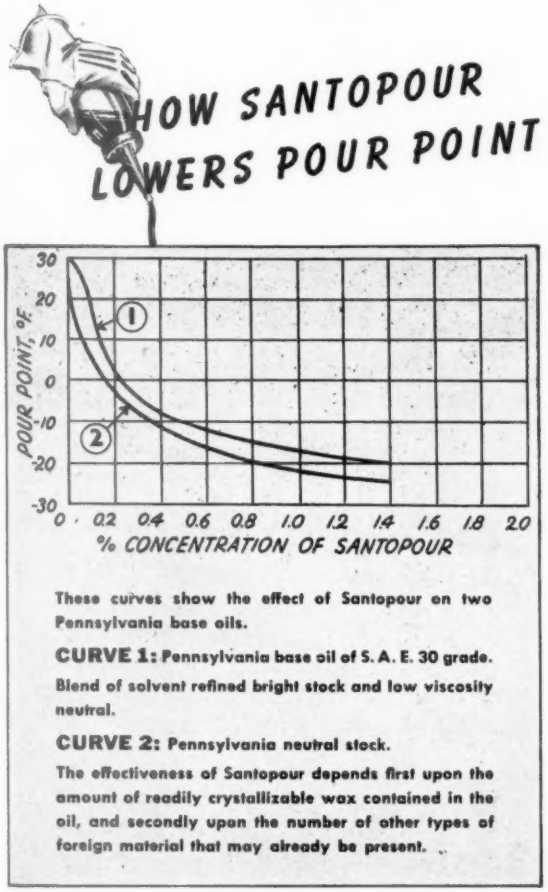

These curves show the effect of Santopour on two Pennsylvania base oils.

CURVE 1: Pennsylvania base oil of S. A. E. 30 grade. Blend of solvent refined bright stock and low viscosity neutral.

CURVE 2: Pennsylvania neutral stock.

The effectiveness of Santopour depends first upon the amount of readily crystallizable wax contained in the oil, and secondly upon the number of other types of foreign material that may already be present.

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substitution of bead for clay catalyst will permit a large increase in plant output or a substantial rise in quality level.

Although bead catalyst produces aviation-base stocks of exceptional quality in conventional multi-pass operation, its performance in one-pass operations is equally striking. For example, by one-step processing of properly selected charge stocks over bead catalyst it is possible to produce good-quality aviation-base stocks for direct blending in high-grade aviation gasolines. This provides considerable flexibility in processing, and may be translated into substantial economic advantages either for wartime or postwar operations.

Further improvement in two-pass processing technique for the production of aviation-gasoline-base stocks has been made possible by combining the advantages of the bead catalyst and the new type reactor. Briefly, the improved technique results in greater yield per unit volume of charge stock, greater production per unit of TCC capacity, and higher quality of the product.

The application of catalytic cracking for motor and aviation-gasoline production has been based almost exclusively on the utilization of gas oils as charging stocks. With the current emphasis on aviation fuels, it is only natural that efforts should be directed toward finding additional sources of charge stocks especially suited for aviation-gasoline production. Recent TCC development work has demonstrated the suitability of a number of stocks for this purpose—stocks which are common to many refineries but which have hitherto been diverted to motor gasoline or other products.

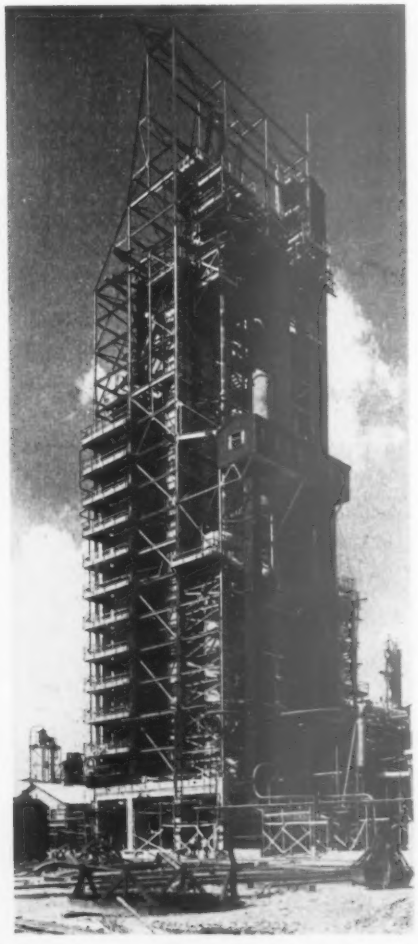
Among the most attractive of these stocks are the light and heavy virgin naphthas. Catalytic reforming of these stocks in TCC units over bead catalyst produces exceptionally high yields of aviation-base stocks having leaded octane ratings of 98 to 100 (AFD-1C). Moreover, the products have well-balanced boiling ranges, and meet all other aviation-gasoline specifications; hence, they may be considered as excellent aviation fuels by themselves, being equal to or superior to alkylate and similar synthetic fuels in many respects. The processing conditions required to obtain the optimum results vary according to the boiling range of the charge stock, but the TCC process has adequate flexibility to meet any choice of conditions without loss in efficiency or throughput capacity. Thus the TCC process opens up still another field of processing which can be done more effectively by catalytic than by conventional thermal means.

In addition to virgin gas oils and light and heavy naphthas, the range of potential charging stocks suitable for TCC processing to aviation gasoline has been extended to include a variety of processed naphthas. These include products obtained by thermal reforming, polyforming, and hydroforming of virgin naphthas. Such stocks may be TCC-processed either over clay or bead catalyst to yield high-quality aviation-base stocks.

Thus far the developments incorporated in the TCC process have been discussed primarily from the standpoint of improving aviation-gasoline production. However, the improvements are of a basic nature and, therefore, enhance no less the value of the process for motor-gasoline production.

As was pointed out in the previous paper,[1] motor gasolines of consistently high quality can be produced by TCC-cracking gas oils over clay catalyst. The clear CFR motor octane number of the motor gasolines normally produced in such operations ranges from about 77 for paraffinic to 82 for naphthenic stocks. However, both the yield and octane number of the gasoline can be varied somewhat by changing the severity of the operation. In this connection, it may be noted that the lighter the charge stock, the more severely it can be cracked within the coke-burning limits of the catalyst regeneration system of the TCC plant, thus permitting an added degree of flexibility.

With bead catalyst, it is possible to obtain still higher yields and quality of motor gasoline from a given cracking stock. The improvement in yield by substitution of bead for clay catalyst is directly related to the higher activity of the bead catalyst, while the CFR motor rating of the product is several octane numbers higher than that from comparable operations on clay catalyst. As applied in TCC processing, bead and clay catalysts are both good desulfurizing agents, with a slight advantage in favor of the beads. Motor gasolines



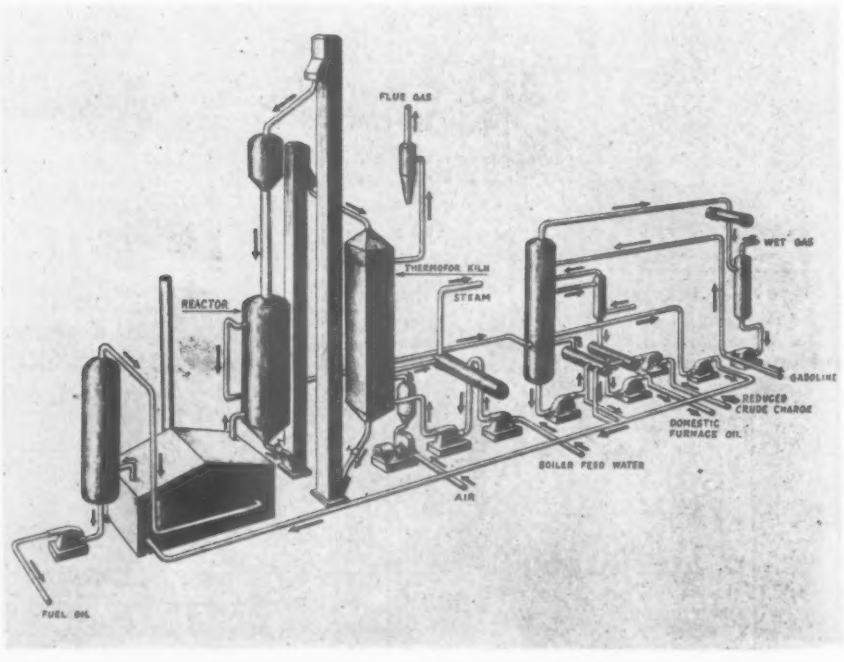


Fig. 1, below flow diagram of Thermofor Catalytic cracking process. Left, new large size TCC unit of Magnolia Petroleum Co. at Beaumont, Texas, which recently went into service

from bead-catalyst operation are also of considerably better volatility than from clay. The overall advantage of the bead catalyst in terms of increased production, saving in tetraethyl lead, and reduced finishing costs thus marks a high standard of performance in the field of catalytic processing for the production of motor as well as aviation gasolines.

Many of the developments made in connection with utilization of charge stocks other than normal boiling-range gas oils for aviation-gasoline production apply equally to motor gasoline. For example, preliminary but unpublishable data indicate attractive possibilities for TCC reforming of certain straight-run naphthas and viscosity-breaker gasoline for motor-gasoline production. In addition, the TCC process can be adapted to the conversion of low-grade stocks of high boiling range, such as are obtained from crude reduction, viscosity-breaking, and coking operations, into motor gasoline and other products.

The TCC process also can be applied to advantage in refineries already having installed catalytic capacity (of the TCC or any other type) to increase their production of aviation or motor gasoline by processing cycle stocks obtained as byproducts from existing catalytic cracking operations. Due to their greater refractoriness, these cycle stocks produce somewhat lower gasoline yields than the corresponding virgin gas oils, but the products are of high quality.

Reviewing these various developments, it is evident that the TCC process now offers the unique possibility of utilizing substantially all crude distillate fractions to produce high-octane aviation-base stock and useful byproducts, with little or no auxiliary processing other than fractionation. In the manufacture of motor gasoline the same latitude in choice of stocks exists and, in addition, the output of motor gasoline from a given TCC unit is much greater than that of aviation gasoline due to the wider boiling range of the product and the elimination of treating operations. This broad application of the TCC process involves utilization of stocks from paraffinic, naphthenic, and mixed-base crudes of both low and high sulfur content. The process is thus destined not only to play a vital role in supplying the present and future high-octane fuels, but also will be an important factor in conserving our petroleum resources. This is now well recognized by the petroleum industry at large, and is reflected in the following list of major oil companies now employing or installing TCC units.

Magnolia Petroleum Co., Gulf Oil Corp., The Pure Oil Co., Sinclair Refining Co., General Petroleum Corp., Continental Oil Co., Crown Central Petroleum Corp., Ashland Oil and Refining Co., Socony-Vacuum Lubrite Division, Richfield Oil Co., Union Oil Co. of California, Socony-Vacuum Oil Co. Inc., Standard Oil Co. of California, Tide Water Oil Co., Sun Oil Co.

TABLE 1—Properties of Typical Aviation Gasolines from TCC Processing of Gas Oils over Clay Catalyst

Source of Gasoline	Naphthenic Gas Oil		Paraffinic Gas Oil		High-Sulfur Gas Oil
Process	Cracking	Treating	Cracking	Treating	Treating
Properties of 7-lb. aviation gasoline:					
Gravity, deg. API	63.1	56.5	67.7	60.9	60.1
Reid vapor pressure, lb.	7.1	7.2	7.0	7.0	6.9
Doctor test	Negative	Negative	Negative	Negative	Negative
Mercaptan-sulfur test	Negative	Negative	Negative	Negative	Negative
Acid heat, deg. F.	67	12	92	14	35
Bromine No.	37.2	4.6	46.1	6.6	17.9
Sulfur, % by weight	0.026	0.022	0.025	0.021	0.061
Accelerated 5-hour gum, milligrams per 100 ml.:					
Inhibited and leaded	...	2	...	4	5
Octane No. (AFD-1C):*					
Without addition of TEL	75.8	81.9	74.4	79.4	79.0
Plus 3 ml. TEL per gal.	87.3	95.9	85.1	94.3	91.7
Plus 4 ml. TEL per gal.	89.5	97.7	87.5	96.3	94.0
ASTM distillation, deg. F.:					
Initial boiling point	108	106	106	105	107
5% point	131	131	130	129	128
10% point	139	140	138	140	136
20% point	150	154	150	153	148
30% point	164	169	165	165	160
40% point	181	188	180	182	180
50% point	200	207	198	200	202
60% point	216	228	213	223	227
70% point	230	246	224	243	250
80% point	245	263	239	259	268
90% point	264	278	260	277	284
End point	304	302	302	305	320
Recovery, % by volume	98.5	98.0	98.0	98.0	98.5
Loss, % by volume	0.5	1.0	1.2	1.0	0.7

*AFD-1C = 1C method, Aviation Fuels Division, CFR committee.

TABLE 2—Properties of Typical Motor Gasolines from TCC Cracking of Gas Oils over Clay Catalyst

	Naphthenic* Gas Oil	Paraffinic† Gas Oil	High Sulfur‡ Gas Oil
Properties of 10-lb. motor gasoline:			
Gravity, deg. API	52.7	60.6	55.2
Reid vapor pressure, lb.	9.5	9.6	10.2
Doctor test	Negative	Negative	Positive
Mercaptan-sulfur test	Negative	Negative	Negative
Copper-dish gum, mg. per 100 ml.	10	16	20§
Glass-dish gum, mg. per 100 ml.	2	1	5§
Oxygen-bomb test, hours and minutes	8:30	12:30	...
Sulfur, % by weight	0.025	0.028	0.106
Octane No.:			
CFR motor method (without TEL addition)	82.0	76.9	78.6
CFR research method:			
Without TEL	92.0	84.1	85.0
With 1 ml. TEL per. gal.	96.5	91.9	88.5
With 2 ml. TEL per gal.	98.5	93.7	90.1
With 3 ml. TEL per gal.	99.2	95.1	91.0
ASTM distillation, deg. F.:			
Initial boiling point	88	90	93
5% point	110	110	118
10% point	125	121	140
20% point	156	145	168
30% point	198	175	199
40% point	237	209	237
50% point	267	243	265
60% point	294	276	297
70% point	322	307	325
80% point	346	337	350
90% point	369	376	372
End point	410	404	404
Recovery, % by volume	97.5	97.5	97.5
Loss, % by volume	1.3	1.5	1.6

*Aniline point, 145° F.
†Aniline point, 176° F.
‡This charge stock had a sulfur content of 1.9% by weight; aniline point, 154° F.
§Gum values after inhibiting with one part of alpha naphthol for 5000 parts of gasoline.

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[1] Simpson, Evans, Hornberg, and Payne, "The Thermofor Catalytic Cracking Process" NATIONAL PETROLEUM NEWS, Nov. 25, 1942, R-427.

Recent Developments in Houdry Fixed Bed Catalytic Processes*

By T. B. Prickett** and R. H. Newton**

Important developments in the Houdry Fixed Bed catalytic cracking process leading to the production of improved aviation base gasolines are the utilization of synthetic catalysts, now manufactured commercially by the Houdry Process Corp., and the two-step operation which includes the catalytic treating of the gasoline produced in the primary cracking. The production of isobutane and butylenes from Houdry units is a substantial contribution to the wartime need.

In the accompanying article the early historical portion of this paper is omitted.

AS THE process development work progressed, it became apparent that the large quantities of aviation base stock believed to be required could not be produced from the available narrow boiling naphtha cuts heretofore considered as optimum charging stocks ([1]). With this thought in mind, and also because a serious shortage in butylenes for alkylation appeared likely, it was realized that heavy cuts must be utilized for the production of aviation base stock. However, as the boiling range of the charging stocks increased, the cracked product tended to become less suitable for aviation fuel. During 1938, Socony-Vacuum Oil Co. produced, on their Houdry unit at Paulsboro, N. J., a low acid-heat aviation base stock by catalytically treating the primary gasoline on clay catalyst. The Houdry laboratory conducted an extensive research program and perfected the application of the procedure for the treating of gasolines produced from a large variety of virgin stocks by synthetic catalyst. The resulting two-step process has been in commercial operation for nearly two years and has resulted in the production of large quantities of superior aviation base stock.

Immediately following our entry into the war, the existing Houdry plants producing high quality motor fuels were converted as rapidly as possible to aviation base production. The quality improvement attained, due in no small part to the synthetic catalysts employed, was of prime importance in increasing the country's output of 100-octane aviation fuel, particularly during the critical first six months of the conflict. During this period the production of alkylate was small. The maximum supplies of finished aviation fuel were only obtainable by blending the minimum possible proportion of the scarce alkylate with the best quality base stocks produced—the output of 14 Houdry static bed plants. The fact that these Houdry plants were in successful commercial operation at that time contributed greatly to decreasing the aviation gasoline shortage. This can be disclosed now because of the vast expansion in alkylate production facilities since the period mentioned.

Another substantial contribution to the war effort by those refiners operating Houdry static bed plants was the production and recovery of isobutane and butylenes for the expanding alkylate industry. Previously the charge to alkylation units generally consisted of isobutane from natural gasoline plants and of butylenes recovered from thermal cracking units. The additional supplies of both these essential products from the Houdry plants materially increased alkylate production.

To convert the existing static bed plants to aviation production and to provide for the newly authorized Houdry units, the original synthetic catalyst plant, started in 1939, was doubled in capacity during 1941 and its production again doubled in the past year.

In addition to improvements made in aviation base quality, there have been advances in plant operating techniques as well. By continued improvement in the mechanical features of the plants, including plant auxiliaries, on-stream time efficiencies have been increased to about 90%. Houdry efficiencies are comparable therefore to those obtainable on general refinery processing equipment.

For example, one 20,000 b/d plant processed a total of 9,000,000 bbls. of gas oil over a period of 17 months during which the plant was on-stream 87% of the elapsed time, which includes the time required to change catalyst at the end of the period. After the change of catalyst this plant was operated above rated capacity for 375 days to satisfy the emergency demand for fighting grade aviation fuel. During this period the on-stream time efficiency was maintained at 95%, including the ensuing second catalyst change and a general inspection and overhaul. After this second catalyst change a careful survey showed that the product yields and qualities were the same as when the plant was initially operated in 1940.

Benefited by the extensive background of Houdry commercial experience extending back to 1936, the new static bed plants are showing improved time efficiency records. Initial periods of experimentation and alteration have not been necessary, as illustrated by the performance of three recently started units. During the first 50 days operation, these three plants operated at on-stream time efficiencies of 96, 99, and 100%. With these favorable starts, these units in all probability will exceed even the best previous operating records.

Notwithstanding the gradual catalytic activity decline which is common to catalytic processes in the petroleum industry, product yields and quality are maintained remarkably constant throughout the catalyst life period. The flexibility of this process permits such a wide variety of conditions that practically all the catalytic activity can be utilized. In consequence, the catalyst consumption of Houdry fixed bed plants is remarkably small.

When the synthetic catalysts were first introduced, a minimum life period of about 12 months was conservatively anticipated, but commercial performance has exceeded expectations. The new synthetic catalysts have operated successfully for periods in excess of 15 months.

Based on a service life of 15 months, a 10,000 b/d Houdry plant consumes an average of 650 lbs. of catalyst daily. Expressed in terms of throughput, this consumption averages one ounce of catalyst per barrel of charge.

In addition to reducing catalyst requirements, the inherent flexibility of the static bed process permits the conversion of a wide variety of charge stocks.

Heavy gas oils crack readily and unless conditions are carefully established there is an excessive loss of desirable products to gas and coke. Conversely, naphthas are refractory and require much more severe conditions to give the optimum results. In the various plants the operating conditions are selected for several charging stocks by choice of proper catalyst activity, adjustment of pressure, and to a lesser degree temperature.

The most active commercial catalysts have more than twice the inherent activity of those of controlled low activity which are used for the heaviest gas oils. Oil partial pressures are varied from subatmospheric to 75 lbs. per sq. in. gauge, and temperature is varied from 800° F. to 875° F. This wide flexibility in choice of conditions is of paramount importance in the cracking of both light and heavy stocks for the production of superior aviation fuels.

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*A portion of a paper under this title presented before Division of Refining, American Petroleum Institute, Chicago, Nov. 11, 1943.

**Houdry Process Corp., Wilmington, Del.

[1] Catalytic Reforming for the Production of Aviation Gasoline—Peterkin, Bates and Broom —ibid 20th Annual Meeting, Nov. 17, 1939.

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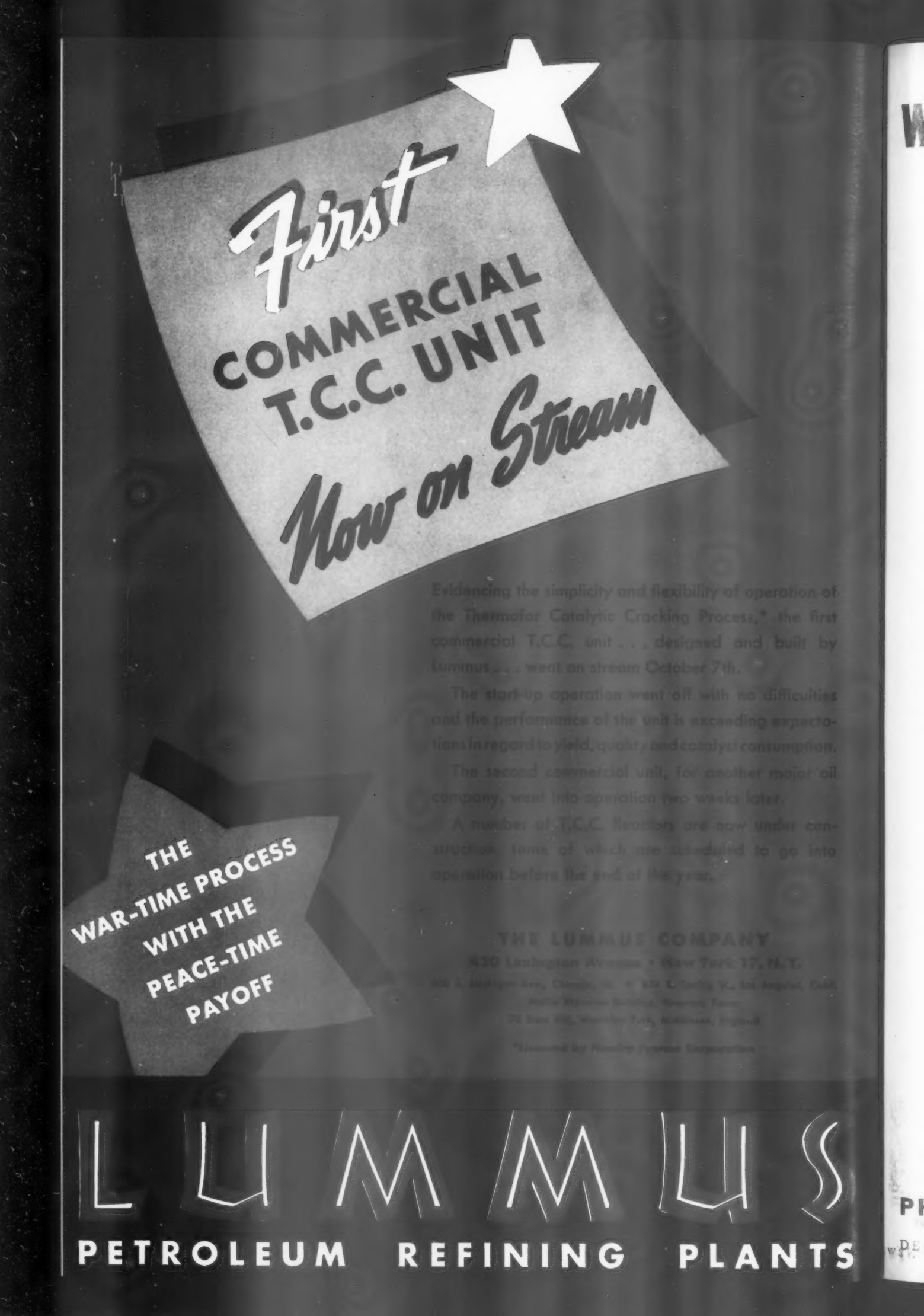
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CRACKING WITH CATALYSTS*

By C. L. Thomas**, N. K. Anderson**, H. A. Becker**, and J. McAfee**

Desired properties in cracking catalysts are listed and those of the U.O.P. catalyst of the synthetic silica-alumina type are described, as related to its use in the Fluid Catalytic Cracking process for the production of aviation gasoline. The process variables of temperature, pressure, space velocity, and length of process period, and their effect on conversion of charging stock are discussed, also other factors which affect the relative yield of various hydrocarbon fractions at a given conversion level. Yields secured with different charging stocks are given.

Methods of finishing the aviation gasoline product include catalytic retreating, "polytreating" and sulfuric acid treating. The two types of commercial units are the original single-stage and the improved two-stage unit which simultaneously cracks raw oil to gasoline and treats the gasoline to make a finished base stock.

IT IS the purpose of this paper to discuss some of the fundamental principles of cracking catalysts and the catalytic cracking process, to give typical results over rather wide ranges of operating conditions and charging-stock quality, and to describe certain important developments of the present commercial design by the Universal Oil Products Co.

In its simplest form, catalytic cracking requires a catalyst and some means for contacting the oil with the catalyst. During the reaction the catalyst becomes fouled with carbonaceous material, and this deposit is customarily removed by combustion. For a better understanding it is advisable to study the separate elements comprising catalytic cracking.

Catalysts

It seemes certain that anhydrous aluminum chloride was the first catalyst used for cracking. The process employing this catalyst was developed by A. M. McAfee in 1913-15. The first catalytic cracking of the type known today may have occurred, in a minor way, incidental to clay treating. It is now generally known that many of the clays used for treating have some cracking activity. Of these clays one type, known as bentonite, forms active catalysts after having been treated with an acid. Montmorillonite, a non-swelling bentonite, has been used widely after acid treating[1]. Montmorillonite is a hydrosilicate of aluminum with a well defined crystal structure; it has the idealized composition of $Al_2O_3 \cdot 4SiO_2 \cdot xH_2O$. Usually some of the alumina is replaced by other oxides, such as magnesium oxide or iron oxide. If the catalyst is heated to about 1200° F or higher, changes take place in the crystal structure, so that the catalytic activity is lost.

The pioneering research on catalytic cracking embodied intensive investigations and tests of the different types of catalysts—natural and synthetic. The limitations of the natural clay catalysts emphasized the many potential advantages of a manufactured catalyst. This early research, which was conducted by Hans Tropsch,[2] laid the foundation and led the way for those who followed. After his death, his associates discovered many additional synthetic catalysts, including the silica-alumina types. Further, they found that, when these are suitably prepared, they are more stable at high temperatures and more active than catalysts from natural sources. In the course of this development certain fundamental principles were discovered:[3, 4]

1. The silica and the alumina should be prepared in an hydrated form by precipitation or gel formation.
2. The hydrated silica and hydrated alumina could be precipitated either together or separately, and then blended.
3. The finished catalyst should be substantially free from soluble metal compounds. Because the catalyst was ordinarily prepared from water glass (sodium or potassium silicates), special washing methods were developed to purify to proper extent.

We believe that every truly synthetic cracking catalyst now used in the aviation-gasoline program embodies in the method of its manufacture the foregoing basic principles.

Silica-alumina was selected as the synthetic catalyst for commercial production for use in fluid catalytic units. The U.O.P. synthetic catalyst, as prepared commercially, is a white granular solid containing both silica and alumina. Under Universal test conditions it has a higher activity than any of the natural silicate catalysts, and it is more stable at high temperatures. The superiority of the synthetic catalyst over natural catalysts is perhaps best illustrated by one of the tests that are applied to the commercially produced catalyst as a quality control. The catalyst is heated to 1650° F for 6 hours and then tested for activity; at least 50% activity remains after this test. Natural catalyst thus tested was reduced to 0% activity.

Life tests were also made on the U.O.P. type "A" catalyst in which the temperature of the catalyst was allowed to rise to 1300° F during each regeneration for 12 regenerations each day for 300 days. During this period more than 300 gal of catalytically cracked gasoline were produced for each pound of catalyst.

These tests emphasize the ruggedness of the type "A" catalyst. But even after methods had been found for obtaining such stability on catalyst produced in the laboratory, there remained the problems of commercial manufacture. Methods for controlling the precipitation and for washing the product had to be worked out. Both the American Cyanamid and Chemical Co. and the Chicago Chemical Co. cooperated in the solution of these problems. Each company now operates a commercial catalytic plant built on the basis of this work, and the catalyst is made according to U.O.P. specifications. Samples

C. L. Thomas — H. A. Becker — N. K. Anderson — J. McAfee

*Presented before Division of Refining, American Petroleum Institute, Chicago, Nov. 10, 1943.

**Universal Oil Products Co., Chicago.

frequently are tested by Universal to insure the quality.

What makes the synthetic silica-alumina a cracking catalyst? So far only part of the answer is known. Each particle of catalyst is highly porous, and these pores are extremely small. Large surfaces are required to form the walls of these small pores; therefore, a single pound of good cracking catalyst has approximately 50 acres of such surface. It is also known that without this surface the white powder ceases to be a catalyst, even though the chemical composition remains unchanged. Strictly speaking, instead of tons of catalyst being made each day, actually millions of acres are produced.

The catalysts derived from natural clays also have large surfaces. If both natural montmorillonite catalysts and the synthetic catalyst are made of silica and alumina, what is the difference between them? Is the synthetic catalyst more active and more stable just because it is purer? The available evidence seems conclusive that the two catalysts are quite different. According to X-ray diffraction results, the natural catalysts are crystalline whereas the synthetic catalyst is amorphous. The results obtained when cracking with the two catalysts are different. For a given gas-oil consumption, the natural catalysts produce more gasoline and less gas than the synthetic silica-alumina. At the same time the gasoline produced by natural catalysts is more olefinic and less aromatic than that produced by the synthetic catalyst under comparable conditions. The synthetic catalyst, although more expensive, is very much superior to the natural catalyst for the production of aviation-base stock because of the low olefinic and high aromatic content of the gasoline.

Contacting Oil With Catalysts

When oil vapors are contacted with either natural or synthetic catalysts, a portion of the oil is converted into other products. The extent of the conversion is dependent upon the operating conditions used.

Effect of Process Variables on Conversion

The most obvious method of contacting oil with catalyst is to pass oil vapors through a fixed bed of catalyst. The variables in such an operation are: 1, temperature; 2, pressure; 3, the quantity of oil charged per unit of time per unit of catalyst (space velocity); and 4, the length of time the oil is passed through the bed before regeneration (process period). The process variables and their effects on conversion of the charging stock may be summarized as follows:

1. *Temperature*: An increase in temperature increases the conversion. The usual temperatures are in the range of 600 to 1100° F.
2. *Pressure*: An increase in system pressure results in an increase of conversion in the lower pressure ranges. Usual pressure ranges are atmospheric to 100 psi.
3. *Space velocity*: A decrease in space velocity increases conversion. Two definitions of space velocity are common: liquid-hourly-space velocity—the ratio of the volume of the oil charged per hour to the volume of the catalyst; and weight-hourly-space velocity—the ratio of the weight of the oil charged per hour to the weight of the catalyst. In fluid catalytic cracking the latter is used. Usual space velocities are 0.1 to 10 weights of oil per weight of catalyst per hour.
4. *Process period:* A decrease in the length of the process period serves to increase conversion. The process period may be as short as one minute and as long as several hours.

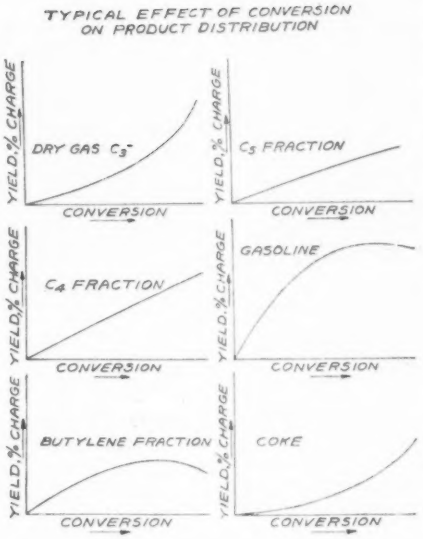

Fig. 1 — Once-through fluid-catalyst cracking of gas oils

In the fluid catalytic cracking process the conversion of oil into other products is dependent upon these same variables. The definition of weight-hourly-space velocity is, just as previously, the weight of oil charged per hour per weight of catalyst in the reaction zone. The weight of catalyst in the reaction zone remains constant, although there is a continuous flow of regenerated catalyst entering the reactor and spent catalyst leaving it. From the rate of flow of catalyst to the reactor and the weight of the catalyst in that vessel, it is possible to calculate the average residence time of a particle of catalyst in the reaction zone.

In the fluid process it is convenient to use the concept of catalyst-oil ratio, which is defined as the ratio of the weight of catalyst entering the reactor per hour to the weight of oil charged per hour. From the units of the three quantities—weight-hourly-space velocity, residence time of the catalyst, and catalyst-oil ratio—it is found that their product is equal to unity. From this fact it follows that, at constant weight-hourly-space velocity, an increased catalyst-oil ratio corresponds to a shorter residence time of the catalyst and, hence, results in an increased conversion.

An increase in conversion, therefore, can be obtained by: 1, a higher temperature; 2, a higher pressure; 3, a lower space velocity; and, 4, a higher catalyst-oil ratio.

Product Distribution in Once-through Fluid Catalytic Cracking

The next information necessary for an understanding of catalytic cracking has been called *product distribution*, i.e., the relative yields of various hydrocarbon fractions at any given conversion level. It has been found that the most important factors affecting product distribution are the type of the catalyst, the conversion level, the temperature, and the quality of the charging stock. The influence of the nature of the catalyst has already been discussed. Inasmuch as only synthetic catalysts are to be used in fluid units for aviation-gasoline production, the present discussion will be limited to U.O.P. type "A" catalyst.

The effect of the conversion level on product distribution is shown graphically in Fig. 1. In these curves the term "conversion" is used in a general sense to mean the degree to which the cracking reactions have proceeded. "Conversion" may be expressed quantitatively as the disappearance of gas oil, as the yield of gasoline and gas or, preferably in some instances, as the yield of C_5 plus lighter hydrocarbons. As shown in Fig. 1, the production of dry gas (C_3 and lighter) increases continuously at an accelerating rate with increased conversion. The yields of C_4 and C_5 fractions increase in a more nearly linear manner. Because C_4 fraction becomes more saturated as conversion is increased, there is a maximum yield of butylenes that can be obtained at a given temperature from any particular charging stock.

The curve showing the yield of gasoline also passes through a maximum; and, in the region of decreasing yield, overcracking is said to be taking place. Like dry gas, the production of coke (the carbonaceous material deposited on the catalyst) increases rapidly with increased conversion. The curves of Fig. 1 are purely diagrammatic, and are intended only to show the general nature of the relation between the conversion level and the yield of some of the products; but in columns "A," "B," and "C" of Table 1 data are given which show some of the effects discussed hereinbefore.

If conversion is held constant, an increase in temperature results in an increase in the production of dry gas and a decrease in the yield of C_5, the yield of gasoline, and the production of carbon. There is evidence that, for stocks of low characterization factor,* the ef-

* Referred to herein as "characterization factor *K*; see reference (5).

fect of temperature on the yield of gasoline is minimized and may be reversed. The effect of temperature on the yield of total C_4's at constant conversion is relatively minor. The results shown in columns "D," "F," and "G" indicate the differences involved.

Product Quality in Once-through Fluid Catalytic Cracking

"Product quality" in catalytic cracking can be considered an extension of product distribution, because it depends upon the relative yields of the different types of hydrocarbons in a given boiling range; i.e., the proportions of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons in each fraction. In general, the same factors affect product quality that influence product distribution; viz., type of catalyst, conversion level, temperature, and quality of the charging stock.

The data given in Table 1 aid in understanding the effects of each of these variables. An increase in conversion in a given temperature range tends to reduce the olefin content of all the products. In the case of the C_4 and C_5 fractions, the decrease in olefin content is accompanied by increases in the proportions of *iso*butane and *iso*pentane. It is interesting to note that the concentrations of *n*butane and *n*pentane remain relatively constant at about 5 to 10% by volume of the C_4 and C_5 fractions, respectively, over the entire range of temperatures and conversion levels normally encountered. The decreased olefin content of the gasoline fraction at higher conversions is accompanied by an increased aromatic content, and these changes together result in superior leaded anti-knock ratings at higher conversions. The fraction boiling just above aviation gasoline and below the initial boiling point of the charge (normally 340 to 400° F) is called heavy naphtha, and is characterized by a relatively low degree of unsaturation—usually with a bromine number less than 10, and a high aromatic content that amounts to 80 to 90% at high conversions. This material ordinarily is blended into motor fuel, for which it has excellent properties; but extensive work is being done at the present time in an effort to convert as much of it as possible into the boiling range of aviation gasoline. The A.P.I. gravity and the characterization factor of the recycle stock (400° F+) decrease markedly with increased conversion.

An increase in the characterization factor of the charging stock at a given conversion level and temperature results in an increase in the unsaturation of all the products. There is an accompanying decrease in the *iso*paraffin content of the C_4 and C_5 fractions, and in the aromatic content of the aviation gasoline. The effect of the quality of the charging stock on the aromatic content of the heavy-naphtha fraction is small.

The effect of increasing temperature at constant conversion is to increase the methane and hydrogen content of the dry gas and to increase the olefin content of all fractions. There is a minor tendency for the aromatic content of the gasoline and naphtha fractions to be increased by high-temperature operation.

Catalytic Cracking of Lighter and Heavier Stocks

The foregoing discussion has been limited to typical gas oils boiling approximately between 400° and 750° F. If a stock with an appreciably lower average boiling point, a kerosine for example, is catalytically cracked, the following differences in results are found: 1. The stock is more refractory; i.e., more severe processing conditions are required to realize a given conversion level. 2. The products are less olefinic than those from a typical gas oil. The gaseous fractions contain more *iso*paraffins, and the liquid fractions are more aromatic. 3. There are only minor deviations from the product-distribution curves discussed hereinbefore unless the initial boiling point of the charge is in the boiling range of the products.

Conversely, heavier stocks are more easily cracked and yield more unsaturated products. Thus it is possible to vary the conversion and quality of products obtainable from a given unit over wide ranges by proper selection of the boiling range of the charging stock. Of great interest in the postwar operation of fluid catalytic units is the possible cracking of topped and reduced crudes without preliminary flashing.

Recycle Operation in Fluid Catalytic Cracking

It is well known that in thermal cracking a higher yield of gasoline can be obtained in a recycle operation than in a once-through operation. It was shown in Universal pilot plants using synthetic catalysts[6] that this same effect holds in catalytic cracking, and that the yield of gasoline can be increased by a recycle operation. Furthermore, it is usually possible to realize the increased yield of gasoline with a more favorable gasoline-to-carbon ratio. In commercial practice, however, it is generally true that, although higher *yields* can be realized by a recycle operation, higher *production* from a given plant is possible in a once-through process. A typical comparison of a once-through and a recycle operation is given in Table 2. In most cases the improvement in yield obtained by recycle operation is accompanied by an improvement in the anti-knock quality of the aviation-base stock.

Finishing

Present aviation-gasoline specifications are such that base stocks of high quality must be relatively low in olefin content and high in aromatic content. These requirements can be met in fluid catalytic plants in two ways: first, the unit may be operated at relatively low temperatures (800 to 900° F.), in which case a base stock having a low bromine number and the necessary high lead susceptibility is produced. However, conversions high enough to correspond to the desired aromatic content are difficult in such an operation on most stocks because of the severity of other operating conditions necessary, and because of relatively high production rates of carbon at the lower temperatures.

As an alternative, the cracking operation can be carried out at higher temperatures and higher conversions. This operation produces a base stock which is rich in aromatics but which, unless unusually high conversions and low characterization-factor stocks are used, contains a higher quantity of olefins than can be tolerated directly in aviation-base stocks. Accordingly, some method of treating this gasoline must be employed.

It was found that, when the gasoline from high-temperature catalytic cracking is contacted with a synthetic silica-alumina catalyst[7] in the temperature range of about 700 to 900° F., a base stock of exceptionally high quality is produced. Not only is the olefin content reduced by hydrogen transfer, but isomerization also takes place; so that a marked improvement in anti-knock quality results. This operation is highly

TABLE 2—Comparison of Once-through and Recycle Operations—Fluid Catalytic Cracking

Operation	330°F, once through		334°F, recycle*	
Charging stock	33°-API, 11.7-K,† 400 to 725°F, gas oil			
Temperature	High			
Combined feed ratio (total feed per fresh feed)	1.00		1.53	
Yields (% Fresh Feed):	% by Weight	% by Volume	% by Weight	% by Volume
Dry gas, C_3	12.7	...	12.0	...
C_4 fraction	11.3	16.8	13.5	19.9
C_5 fraction	8.0	10.9	9.4	12.9
Depentanized C_6 at 400°F.	25.0	26.8	31.9	34.8
Recycle stock, 400°F+	37.8	36.9	27.7	26.7
Catalyst carbon	5.2	...	5.5	...
Total	100.0	91.4	100.0	94.3

* Total 400°F+ recycle stock returned with fresh feed in amount indicated.
† UOP characterization factor.

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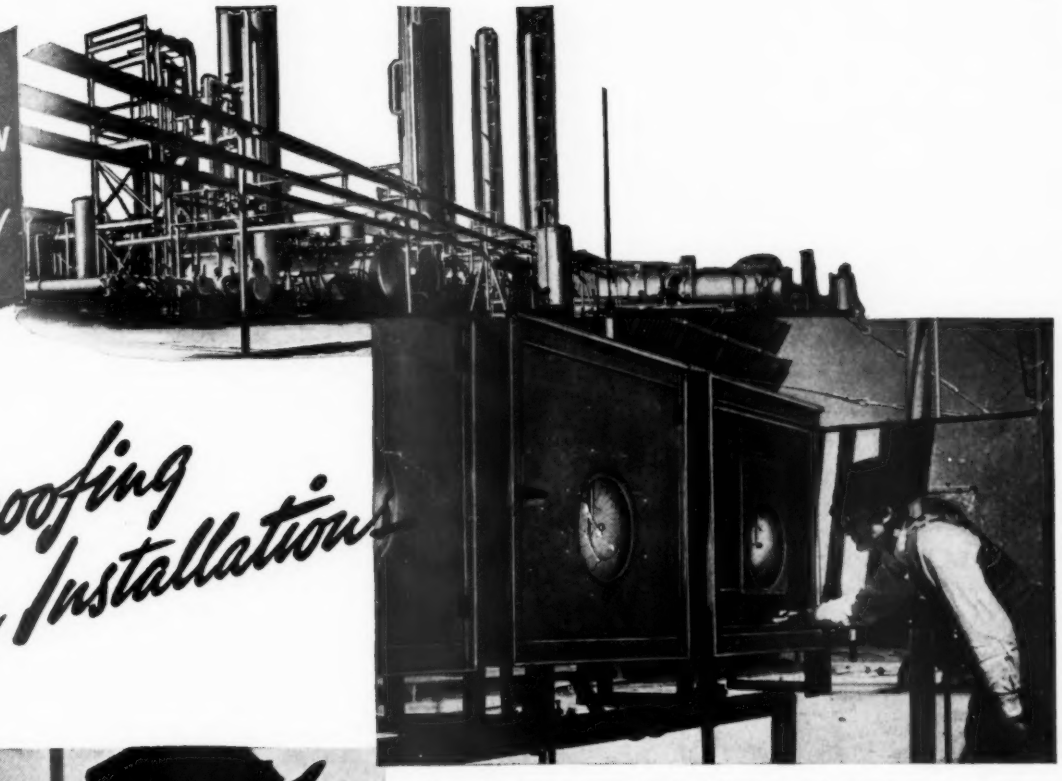

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Table 1—Typical Once-through Fluid-Catalytic-Cracking Results

Column	A	B	C	D	E	F	G
Charging stock:	Gas Oil (400 to 725 Deg F)						
Gravity, deg API at 60 deg F.	25.2	25.2	25.2				
UOP characterization factor K^5	11.2	11.2	11.2	11.7	12.2	11.7	11.7
Temperature	High					Intermediate	Low
Conversion:							
Per cent by weight of C_5 and lighter	15.0	25.0	35.0	25.0	25.0	25.0	25.0
100—per cent by volume of recycle stock (400 deg F+)	46.1	65.3	75.9	56.0	46.4	58.4	60.7

	A		B		C		D		E		F		G	
	Per Cent by Weight	Per Cent by Volume	Per Cent by Weight	Per Cent by Volume	Per Cent by Weight	Per Cent by Volume	Per Cent by Weight	Per Cent by Volume	Per Cent by Weight	Per Cent by Volume	Per Cent by Weight	Per Cent by Volume	Per Cent by Weight	Per Cent by Volume
Yields, per cent of charge:														
Dry gas, C_3 and lighter	6.0	...	10.1	...	14.5	...	9.5	...	7.7	...	7.5	...	4.9	...
C_4 fraction	5.6	8.6	9.4	14.4	12.8	19.7	9.4	13.8	9.2	13.0	10.0	14.7	10.9	16.0
C_5 fraction	3.4	4.9	5.5	7.9	7.7	11.0	6.1	8.3	8.1	10.7	7.5	10.3	9.2	12.6
Depentanized gasoline, C_6 at 400 deg F.	28.0	30.9	34.5	37.9	30.2	33.2	25.9	28.2	19.4	20.8	27.5	29.8	27.1	29.3
Recycle stock, 400 deg F+	54.9	53.9	35.8	34.7	25.1	24.1	45.1	44.0	54.4	53.6	42.6	41.6	40.2	39.3
Catalyst Carbon	2.1	...	4.7	...	9.7	...	3.9	...	1.2	...	4.9	...	7.7	...
Total	100.0	98.3	100.0	94.9	100.0	88.0	100.0	94.3	100.0	98.1	100.0	96.4	100.0	97.2
Product quality:														
Dry gas, C_3 and lighter:														
Mol per cent H_2	12		13		13		12		10		7		4	
CH_4	21		23		25		21		20		15		18	
C_2H_4	11		8		6		10		12		8		6	
C_2H_6	7		9		11		7		5		8		7	
C_3H_6	29		21		12		35		51		34		28	
C_3H_8	20		26		33		15		4		28		37	
Total	100		100		100		100		100		100		100	
C_4 fraction:														
Liquid, per cent by volume of:														
iC_4H_8	14		11		6		17		22		7		3	
nC_4H_8-1	15		11		6		17		22		7		3	
nC_4H_8-2	6		7		7		8		11		14		11	
iC_4H_{10}	55		61		71		48		35		62		73	
nC_4H_{10}	10		10		10		10		10		10		10	
Total	100		100		100		100		100		100		100	
C_5 fraction:														
Liquid, per cent by volume of:														
C_5H_{10}	45		37		26		49		58		31		19	
iC_5H_{12}	47		55		66		43		34		61		73	
nC_5H_{12}	8		8		8		8		8		8		8	
Total	100		100		100		100		100		100		100	
Depentanized aviation-base stock, C_6 at 340 deg. F.:														
Gravity, deg. API at 60 deg. F.	52		47		42		50		55		50		50	
Bromine No.	34		25		20		42		59		28		13	
Aromatics, per cent by weight	40		60		75		42		28		42		42	
Octane No., 1-C plus 4.0 ml. TEL per gal.	90.8		(94)		(97)		89.8		(88)		92.3		94.2	
Heavy naphtha, 340 to 400 deg. F.:														
Gravity, deg. API at 60 deg. F.	30.8		29.6		27.7		33.5		33.4		32.1		33.2	
UOP characterization factor K	10.79		10.68		10.56		10.95		10.95		10.88		10.94	
Aromatics, per cent by weight	67		73		81		69		80		67		69	
ASTM Octane No.:														
Without addition of TEL	87.7		90.0		90.5		83.0		83.7		85.0		83.3	
Plus 3.0 ml TEL per gal.	90.5		91.5		91.7		87.2		87.3		86.6		87.4	
Recycle stock, 400 deg. F.+:														
Gravity, deg. API at 60 deg. F.	22.7		20.3		19.2		28.7		36.9		28.5		28.5	
UOP characterization factor K	10.84		10.70		10.65		11.37		11.83		11.26		11.27	

Fig.

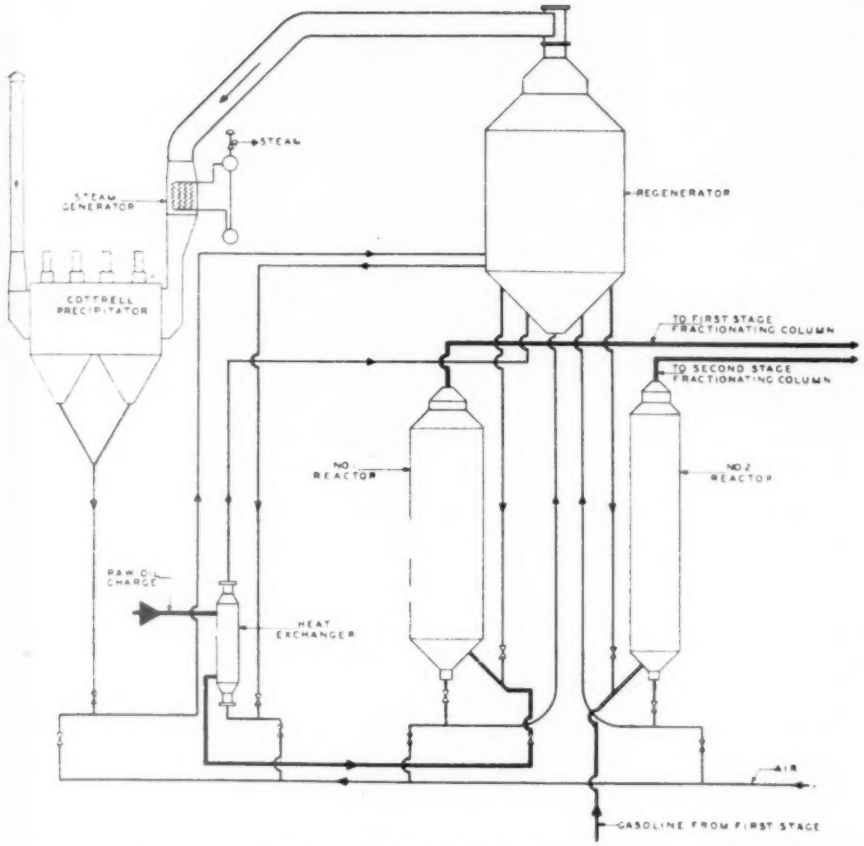

Fig. 2—Flow diagram of two-stage unit (two reactors with common regenerator)

desirable in many instances, particularly when paraffinic charging stocks are processed. However, the equipment for fluid catalytic treating can be employed for additional gas-oil cracking, so that the desirability of fluid catalytic treating depends upon a balance between the production rate and the quality of the base stock, as well as upon other factors which necessitate a separate evaluation of each refinery situation.

A second method of removing olefins from gasolines is sulfuric-acid treatment. The removal of the olefins and, in the case of high-sulfur stocks, the simultaneous desulfurization realized result in marked improvement in lead susceptibility (hence, leaded octane number). However, the rearrangement of the other components of the gasoline through fluid catalytic treating is not realized, and the improvement in quality is inferior to that obtained in the catalytic treating step. This difference in quality is offset in part by a considerable reduction in the amount of equipment required, and can be minimized further by the operation of the first-stage cracking step at higher conversion levels. Accompanying the acid treatment, of course, is a loss of hydrocarbons and an appreciable consumption of acid.

A third finishing method is a relatively new Universal development known as "polytreating." This operation comprises liquid-phase treatment of the gasoline in the presence of a U. O. P. solid catalyst. The results are comparable with those which can be realized by sulfuric-acid treatment, because the principal reaction in both processes is the removal of olefins. The improvement in quality is, therefore, largely a result of the improved lead susceptibility resulting from removal of the olefinic compounds. The prime feature of this process is the long life of the catalyst, which makes it economically attractive. The high-boiling material produced in this operation is quite satisfactory for catalytic recracking; thus the volumetric loss of aviation fraction attending the polytreating operation itself is not chargeable against the combined catalytic cracking and treating operation, as a large part of the bottoms can be recovered as aviation gasoline in the recracking step.

Present wartime restrictions preclude a tabulation showing the superior antiknock quality of the base stocks, but it may be stated that fluid catalytic treating produces a quality of base stock not approached by the other treating methods.

The catalytic cracking and treating process would be extremely simple if it were not for the fact that during processing a carbonaceous deposit forms on the surface of the catalyst. This deposit seriously impairs the effectiveness of the catalyst, and makes necessary its periodic regeneration. Thus, the problems of minimizing the production of the deposit and of removing it without permanently damaging the activity of the catalyst are of major concern.

From fundamental studies it was learned that excessive temperatures are detrimental to the activity of the catalyst. And yet high temperatures are practically synonymous with regeneration, because the latter is accomplished by combustion of the carbonaceous deposits. When the problem of regeneration in a fixed-bed of catalyst is examined, it soon becomes apparent that combustion with air without cooling is, in most cases, not possible without subjecting the catalyst to such temperatures in the burning wave that its catalytic activity is soon destroyed. The most common expedients for controlling this temperature are dilution of the regeneration air with inert gases and provision for internal cooling.

In the regeneration of fluid catalyst the problem is the same—extremes of temperature must be avoided. The turbulence and constant circulation of the particles of catalyst make it impossible to build up appreciable temperature gradients in the regenerator or to realize the burning-waves characteristic of regeneration in a fixed bed. This same condition in the regenerator also permits the use of undiluted air without preheating.

Commercial Fluid Catalytic Cracking Units

The basic type of commercial fluid catalytic cracking unit, the so-called "single-stage" unit, consists fundamentally of a regenerator and single reactor. When it is desirable to treat by means of fluid catalysts the gasoline made on a single-stage unit, it is necessary to resort to a "blocked-out" operation—in which gasoline is produced for a few days, then treated in the same equipment. Although this type of operation is feasible, it has the disadvantages of lower calendar-day throughput, of increased tankage requirements, and of the necessity of changes in operating conditions while the unit is onstream.

The "two-stage" unit, which simultaneously cracks raw oil to gasoline and treats this gasoline to make a finished base stock, avoids these difficulties. The two-stage unit consists of two reactors with a common regenerator, each reactor running under the optimum conditions for the task it is performing. Inasmuch as the two-stage unit can be run with both reactors on cracking, if desired, it offers a wide range of operating flexibility and control of the quality of the product.

In the following description of the flow (wartime restrictions have prevented the presentation of a detailed flow diagram) the equipment involved in cracking will be called "first-stage," whereas that on treating will be called "second-stage."

The raw-oil charging stock, usually gas oil, is preheated by heat exchange

with a recirculating stream on the first-stage fractionating column; it then goes to the catalyst-to-oil heat exchanger, where it receives further preheat from a stream of catalyst which circulates between the exchanger and the regenerator. The primary purpose of this heat exchanger is to give a wide degree of flexibility to the catalyst-to-oil ratio on the first stage. As there is a definite amount of heat to be removed from the regenerator, it is, obvious that when part of it is transferred in the heat exchanger, there will be less left to be transferred by the catalyst circulating between the regenerator and the reactor; thus a lower catalyst-to-oil ratio is permitted.

Any additional heat required by the reactor is supplied by means of a fired tubular heater, in which the charge is heated further. The raw oil then enters the reactor riser, where it comes into contact with the hot regenerated catalyst flowing from the regenerator. The oil is now completely vaporized, and the catalyst is fluidized to a relatively light condition so that the mixture flows upward into the reactor. Usually recirculated process gas or steam is injected into the reactor riser to aid in fluidizing the mixture.

The vapors leaving the reactor carry some of the catalyst fines with them. The major portion of these catalyst fines is recovered by passing the vapors through cyclone separators. The remainder of the fines is recovered as a slurry at the bottom of the fractionating column.

The products of the reaction are then fractionated in the first-stage fractionating column and gas-concentrating equipment, from which a gasoline cut is returned to the second-stage reactor for treating—usually at a somewhat lower space velocity and temperature. Heat is furnished to the second-stage reactor principally by hot catalyst from the regenerator, the catalyst-to-oil ratio in this stage being relatively high. From the second-stage reactor the treated product passes to the second-stage fractionating and gas-concentrating sections for separation.

The air required for combustion of the carbonaceous material on the spent catalyst enters at the base of the regenerator risers and carries the catalyst upward into the regenerator. As the regenerator is quite large—some regenerators being more than 40 ft. in diameter—a perforated plate is installed to insure even distribution.

The regenerated catalyst flows into the drawoff wells, down to the two reactors, and on to the catalyst-to-oil heat exchanger. The material in the stand pipes is quite dense, so that the head developed is sufficient to cause the catalyst to flow into the reactors and heat exchanger—the flow rates being controlled by the slide valves. The products of combustion leave the regenerator through a cyclone separator, which removes the greater part of the entrained catalyst. The gases then go through a steam generator, which recovers a large part of the waste heat, and then through a Cottrell electrical precipitator, which recovers most of the remaining catalyst. From there the gases are discharged into the atmosphere.

The demands of war have occasioned intensive study of internal-combustion-engine design for greater power output and new fuels have had to be developed for use in the new engines. Fortunately the petroleum industry was ready at the outbreak of war with new processes to produce such fuels. Catalytic cracking had been developed of such flexibility that it was possible to meet the stringent requirements of our armed forces.

There is no doubt that after the war automotive-engine designers will incorporate many features of aircraft-engine design in automobiles, and they will premise their designs on the availability of fuels of much higher quality than those which existed before the war.

There need be no apprehension on the part of the small refiner as to the utility and economy of adapting catalytic cracking to his refinery operations after the war. Although it is true that the cost of such installations may not seem attractive at this time, nevertheless the continued development and refinement of the process shows a progress which is most encouraging. It is a foregone conclusion that he will benefit greatly from the present activity of research and development in this art. The many large and costly commercial installations are the proving and developing grounds for refinements which will produce the plants of the future to fit the capacity and pocketbook of the small refiner. History has demonstrated that the processes will be available for his use. A new process, not fully developed, requires venture capital to prove or disprove it commercially. This risk is taken by the large refiners. The successes and experiences are converted into profitable operation for small refineries so important to our national welfare and economic fabric.

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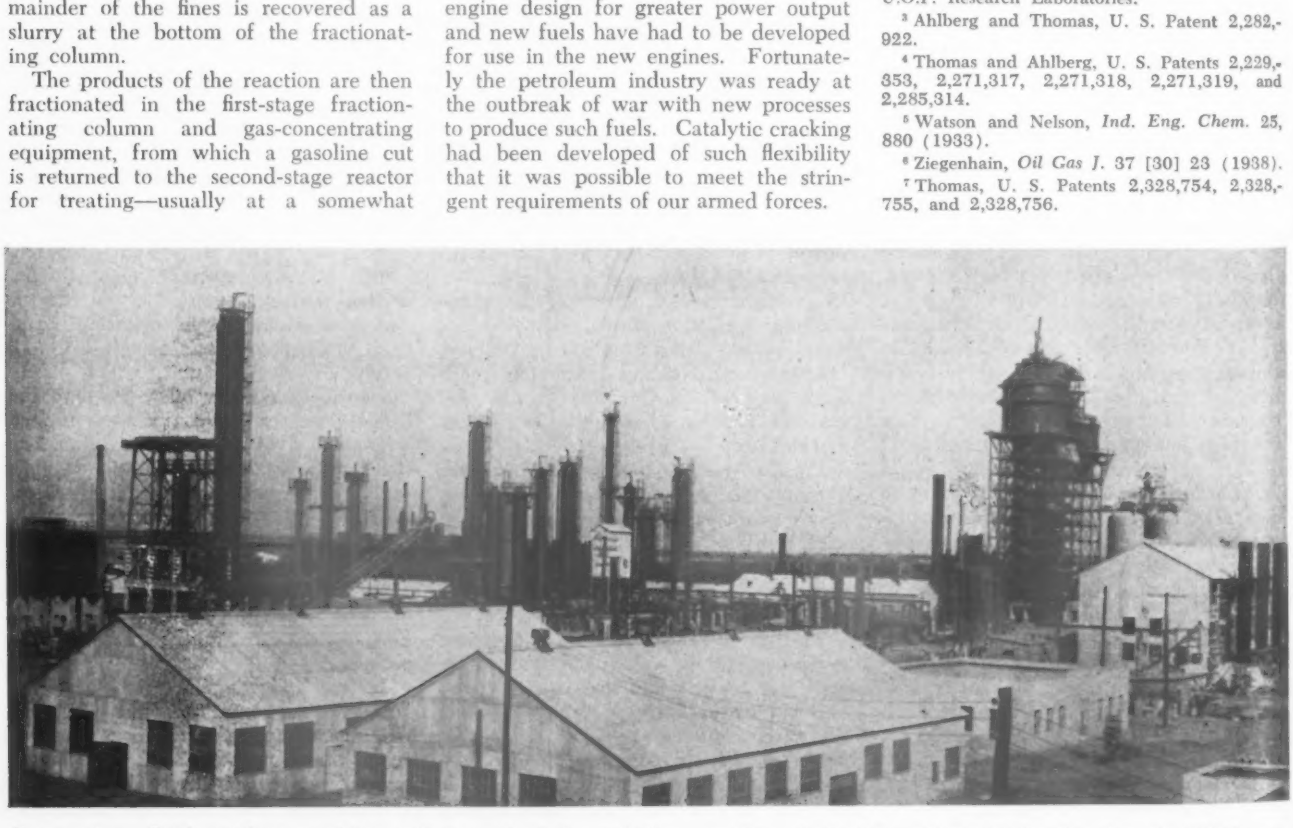


A two-stage fluid catalyst cracking unit is part of the aviation gasoline plant of Associated Refineries, Inc., in Oklahoma. In this view, showing the plant in the final stages of construction, the cracking unit is at the right, and the common regenerator for the two reactors is at the top of the structure

Fluid Catalyst Cracking for Premium Fuels*

By E. V. Murphree**, H. G. M. Fischer**, E. J. Gohr**, W. J. Sweeney** and C. L. Brown***

The commercial Fluid Catalyst Cracking process plants are now operating to provide maximum quantities of highly aromatic base stocks for aviation gasoline and raw materials for alkylate, as well as for synthetic rubber and toluene. Typical applications are described and qualities of products given, in so far as the data can be made public at this time.

The accompanying is only a portion of the paper under this title as presented. Earlier sections covering the commercial history of the process, description of plants and operations to produce motor-fuel gasolines are omitted. For data on these subjects readers are referred to NATIONAL PETROLEUM NEWS, Technical Section of Feb. 3, 1943, p. R-56, "20-Story Cracking Plant Makes Aviation Gasoline by Fluid Catalytic Method", and Technical Section of June 2, 1943, p. R-251, "Producing Aviation Gasoline by Fluid Catalytic Cracking".

ALL commercial Fluid Catalyst Cracking plants now in operation are engaged in the production of war products. The fundamental difference between motor and war-products operations lies in the catalysts which govern the cracking reaction. The catalyst now in use in fluid plants producing war materials is a synthetic material which is particularly applicable to this type of operation. Due to the role that these operations are playing in supplying the nation's current military needs, only a general discussion of types of operation and qualities of products can be made at this time.

In cracking with synthetic catalyst, as with any other type, product distribution and naphtha composition are affected to a large extent by the type of feed stock charged, and by the temperature and depth of conversion at which cracking is carried out. The general effect of these variables when gas oils are processed is summarized as follows:

a. *Temperature:* Formation of saturated paraffins at a given conversion is favored by low temperatures. Aviation gasolines produced at the lower temperature levels are characteristically high in saturated iso-paraffin content, but are low in aromatic concentration. High-temperature operations, on the other hand, lead to more highly unsaturated and, particularly, more aromatic fuels. Unsaturation in the butane and pentane fractions is affected similarly.

b. *Conversion:* Depth of cracking affects both yield and composition to a major degree. The higher conversions, at a given temperature, yield more highly aromatic and more saturated fuels.

c. *Feed stock:* Naphthenic feed stocks can be cracked to satisfactory yields of aviation gasolines which are generally of higher quality than those obtained from paraffinic stocks. With a given type of stock, boiling range also affects results—the lighter and more refractory stocks generally yielding products which are more saturated. It is to be mentioned that, regardless of the cracking conditions at which a naphtha is produced, further catalytic processing of this naphtha in subsequent and separate operations will result in further improvement in aviation-gasoline quality, largely through the elimination of olefinic compounds.

Flexibility Permits Choice

In applying catalytic cracking to the production of war products, therefore, optimum type of operations are determined by consideration of combined refinery operations, inasmuch as, for example, the production of raw materials for alkylation is of equal importance to the production of aviation-base stock itself. The flexibility of the fluid catalyst process permits choice of cracking operations over wide ranges of temperature, conversion, and feed stocks; and thus the operations which are most suitable to a particular refinery situation can be applied readily. With current aviation-fuel specifications and demands, single-pass high-temperature operations at moderate conversions appear optimum from a standpoint of utilizing most efficiently a given cracking capacity when cracking paraffinic-type stocks.

Characteristics of typical aviation-gasoline-base stocks produced over a rather wide range of conditions in commercial units are given in Table 1. It will be noted that the higher temperatures of operation give, before further treatment, a total aviation cut having somewhat poorer AFD†-IC anti-knock quality than that produced in low-temperature cracking. This is due primarily to the more highly olefinic nature of the high-temperature stocks—which, however, are more aromatic. It is pertinent that the olefins in the catalytic naphthas are concentrated largely in the fraction boiling up to 225°F. In practice, therefore, this fraction generally is treated to remove olefins, whereby a superior-quality fuel is produced, or is discarded to motor fuel and replaced by natural naphtha while the heavy highly-aromatic naphtha in the 225- to 350°F. boiling range is blended directly into aviation naphtha. The production of raw materials for alkylation is considerably higher in high-temperature cracking; and, when overall aviation production is under con-

TABLE 1—Typical Product Quality of Catalytic Aviation-Base Stocks—Commercial Operations—Synthetic Catalyst

	Paraffinic Feed Stocks				Naphthenic Feed		
	Single-Stage			Two-Stage	Single-Stage		
Type of Operation:							
Temperature level:	Low	High	Hydrogenation*	High	Low	High	High
Feed stock (gravity, deg API)	36.7	36.1	36.1	30.5	33.8	29.6	29.6
Gas-oil conversion, %	52.7	64.0	64.0	60.0	56.6	63.5	81.3
Aviation Gasoline:							
Reid vapor pressure, lb.	7.0	7.0	6.8	7.0	7.0	6.9	6.9
Gravity, deg API	61.5	56.4	58.2	57.8	57.7	55.8	51.3
Aniline point, deg F.	92	45	84	69	75	34 †	24 †
Acid heat, deg F.	56	135	6	36	44	144 †	100 †
Bromine No., centigrams per gram	22	64	0	12	22	45 †	22 †
Sulfur, per cent by weight	0.02	0.03	...	0.03	0.03	0.03†	0.03†
ASTM distillation:							
Per cent by volume over at:							
167°F.	33.5	34.5	28.5	31.0	29.0	28.5	24.0
221°F.	61.0	56.5	54.0	55.0	53.0	55.5	46.5
275°F.	84.5	80.0	81.5	77.0	77.5	85.0	75.0
293°F.	91.0	90.0	91.0	90.0	88.5	92.7	91.4
End point, deg F.	332	332	318	318	326	319	320
Octane No.:							
ASTM: without addition of TEL	81.0	82.7	80.4	83.2	81.5	81.7 †	86.0 †
AFD-1C: plus 4 ml TEL per gal.	93.3	91.7	98.2	96.5	94.9	92.6 †	97.4 †

* Shows high-temperature gasoline from column 2 after hydrogenation.
† Inspected on pentane-free basis.
‡ Rated with pentanes added for 7 lb Reid vapor pressure.

*A portion of a paper under this title presented before the Division of Refining, American Petroleum Institute, Chicago, Nov. 11, 1943.

**Standard Oil Development Co., Elizabeth, N. J.

***Standard Oil Co. of Louisiana, Baton Rouge.

†Aviation Fuels Division.

sideration, cracking at these conditions is definitely superior to that at low levels.

Elimination of the olefinic constituents of the naphthas produced at high temperatures to improve AFD-1C anti-knock quality may be accomplished in a number of ways. Two methods which have been utilized commercially are hydrogenation and catalytic treating. Results obtained from such processing are shown in Table 1, and it is apparent that final products of high anti-knock quality (96.5-98.0 AFD-1C) result. Another method is the application of severe acid treating, whereby comparable improvements may be obtained through removal of olefins by polymerization. Spent alkylation acid has been found to be suitable for this treatment. Inasmuch as most of the integrated aviation-gasoline operations use alkylation, the application of acid treating is of considerable interest.

Naphthenic stocks yield, in general, better quality aviation-base stocks than paraffinic feeds at comparable cracking conditions. Table 1 illustrates that extremely high-quality stocks can be produced when cracking proceeds at severe once-through conditions. Severe operations of this nature produce increased quantities of aromatics in the aviation-gasoline boiling range, and reduce at the same time the olefins which reduce AFD-1C anti-knock quality.

Combination With Other Refinery Processes

To evaluate properly catalytic-cracking operations for production of aviation fuel, the process must be considered in combination with other refinery processes, particularly alkylation; because, in a broad sense, catalytic cracking is essentially a source of alkylate as well as of premium aviation-base material.

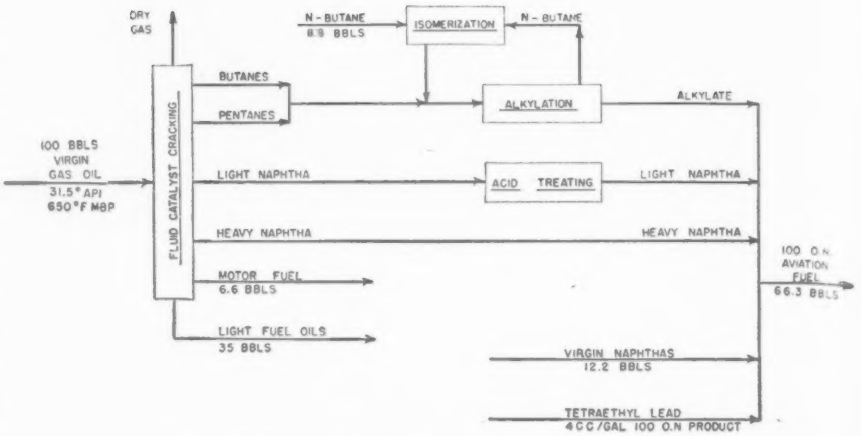


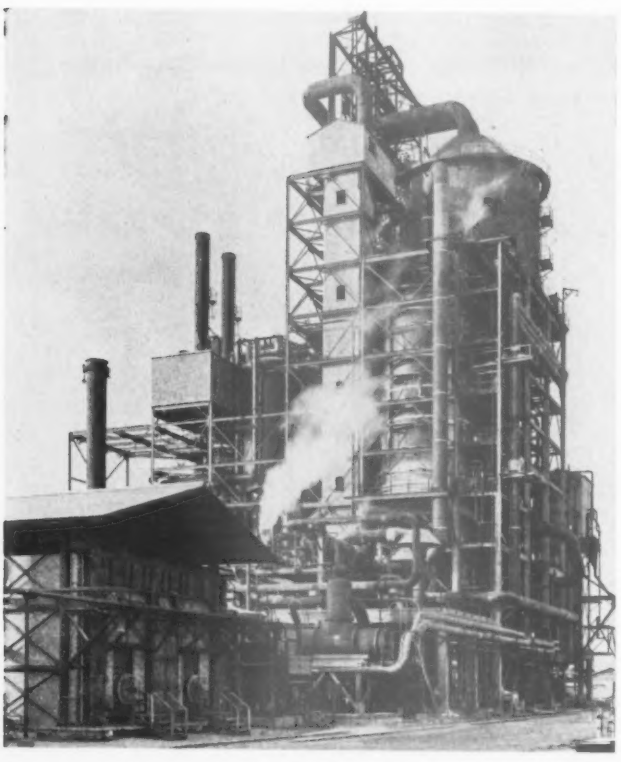
Fig. 1—Aviation Gasoline by Fluid Catalyst Cracking

One application of Fluid catalytic cracking in integrated refinery operations for aviation-fuel production is outlined in Fig. 1. This illustration is based on processing a typical heavy-paraffinic gas oil at high temperature; the butylenes and amylenes produced are alkylated with *iso*butane, and the light catalytic naphtha is severely acid-treated with sulfuric acid to improve AFD-1C anti-knock quality by removing the olefins therein. The catalytic heavy-aromatic fraction, which is high in anti-knock quality as produced, is blended directly into the final gasoline. The blend of alkylate and naphthas from the catalytic operation is substantially higher in octane number than specifications require, and readily available virgin naphthas, which are of comparatively low quality, are blended in such quantity that the final blend will meet specifications—thereby increasing the volume of specification aviation product. In this scheme of operations, some *iso*butane is necessary to supplement the *iso*butane produced in catalytic cracking which supplies a quantity that is roughly sufficient to alkylate only the butylenes. Normal butane, which is generally available, is isomerized readily to *iso*butane in relatively simple and inexpensive equipment.

High Yield Is Obtained

The yield of aviation gasoline resulting from the combination of processes discussed (Fig. 1) is quite high. For every 100 bbl. of heavy paraffinic gas oil charged to the Fluid catalyst unit, it is possible to produce 66.3 bbl. of 100-octane-number aviation fuel meeting present specifications. Of this quantity, 12.2 bbl. are virgin-naphtha fractions which can be carried in the blend. A substantially higher yield of aviation gasoline can be obtained by hydrogenating, rather than acid-treating, the light catalytic naphtha. Production of specification aviation fuel from such a scheme of operation is indicated to be 78.4 bbl. per 100 bbl. paraffinic virgin gas oil charged to cracking.

With the completion of the present construction program, the Fluid catalyst process will be the major cracking process for producing 100-octane aviation gasoline. On resumption of normal economic conditions after the war, the Fluid process will provide a means of converting the heavier petroleum fractions with maximum efficiency and economy into premium motor fuels.

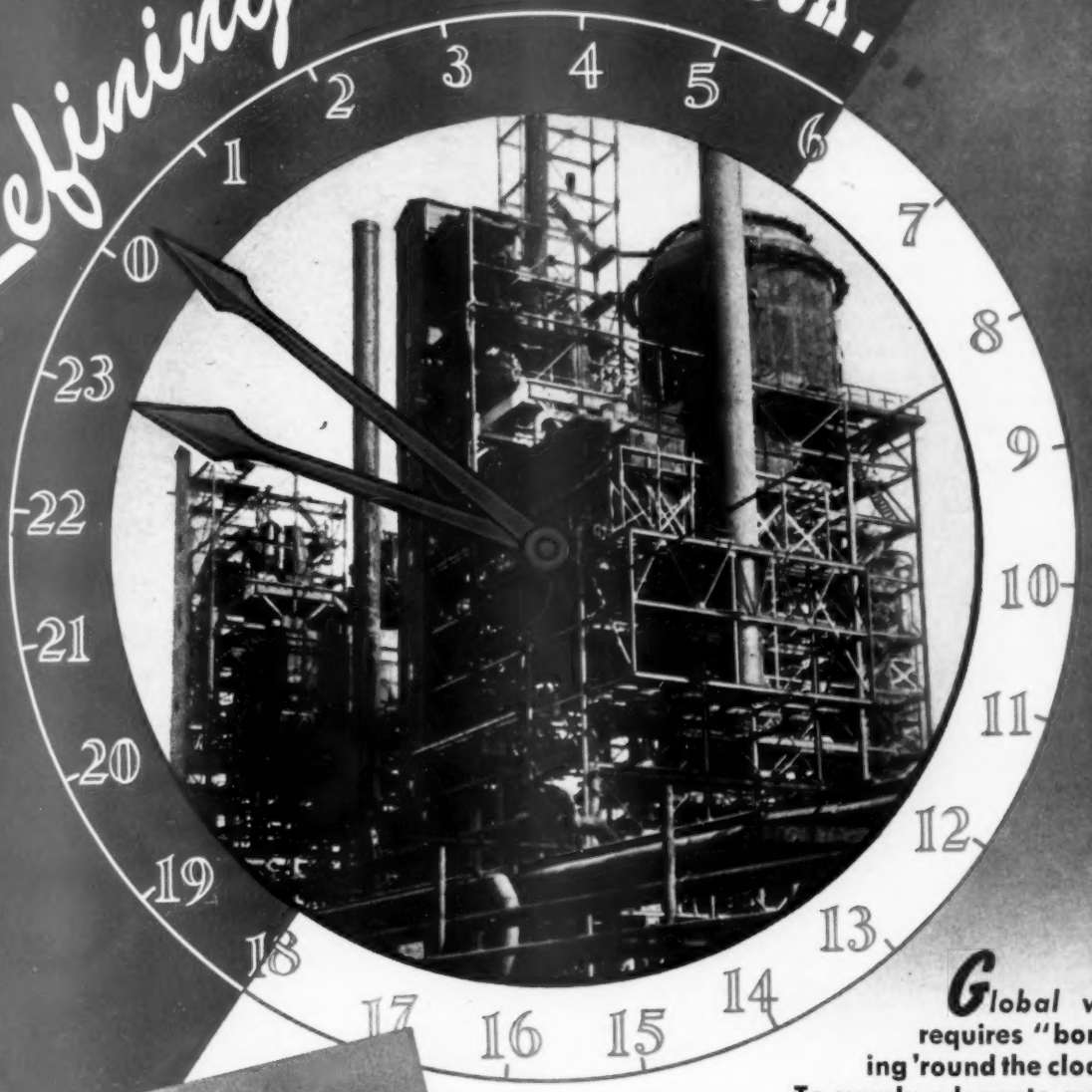


Two-stage Fluid Catalyst cracking plant of Shell Oil Co., near Wilmington, Calif., officially dedicated Nov. 13. The structure is 240 ft. high

ACKNOWLEDGMENT

The Fluid catalyst process represents a contribution of the Standard Oil Development Co. to a co-operative study on catalytic refining participated in by the refining organizations of Standard Oil Co. of New Jersey, and by Anglo-Iranian Oil Co., Ltd., M. W. Kellogg Co., Shell Oil Co. Inc., Standard Oil Co. (Indiana), The Texas Co., and Universal Oil Products Co.

Refining 'round the clock...



Global war requires "bombing 'round the clock." To supply adequate quantities of fuel for our bombers, American refineries producing high-octane aviation gasoline must continue "refining 'round the clock."

Fluid catalytic cracking plants designed and constructed by Kellogg are contributing their full share to this program by producing at capacity on 24-hour per day schedules.

As Allied bombings are stepped up in intensity, additional Kellogg-built plants about to go on the line will augment our output of vital aviation gasoline and insure no let-up in our softening up program.

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THE ANALYTICAL CHEMIST ON THE SPOT

(A Report on TAC Analytical Subcommittee*)

By Harry Levin**

Proper and adequate analytical methods are necessary to ensure the efficient operation of the new highly technical processes producing petroleum products of an increasingly higher degree of purity. The important function of the analytical chemist in today's plant operations is brought out in an historical sketch of the origin and work of the Analytical Subcommittee of the Technical Advisory Committee of the Petroleum Industry War Council.

EARLY in 1942, when the country was in the throes of an agonizing excitement over synthetic rubber, the ancestor of TAC was born. The Petroleum Industry War Council appointed a committee on synthetic rubber and it created a subcommittee of technologists to cope with the emergency anticipated from the unbalanced situation expected from styrene capacity being far in advance of butadiene plants. This Technical Advisory Committee of the Committee on Synthetic Rubber, after a prompt survey of existing refinery capacity and a study of methods of making butadiene from petroleum, collaborated with the Petroleum Administration for War in a proposed large scale refinery conversion program. This so-called "quick butadiene" program was an emergency measure to increase butadiene production so it would be more nearly apace with the anticipated faster production of styrene, the other base material for synthetic rubber of the Buna-S type.

Construction of new butadiene plants progressed faster than expected and rendered part of the refinery conversion program unnecessary. Though the emergency for which TAC was created had passed, the benefits to be derived from the services of such a body were obvious. Hence in October, 1942, William R. Boyd, Jr., chairman of the Petroleum Industry War Council appointed a Technical Committee with Robert E. Wilson, chairman, to supervise activities of a new Technical Advisory Committee whose nucleus was the older rubber committee.

There are 20 members on the TAC, representing the best research and development facilities of the petroleum industry in this country. This committee carries on its technical work through three working subcommittees; namely, the Synthesis Subcommittee, the Primary Processes Subcommittee and the Analytical Subcommittee. The activities of the latter committee since its inception in October, 1942, is the subject of this paper.

Like its parent organization the TAC, membership on the Analytical Subcommittee is entirely voluntary and the expenses incidental to conducting the work are borne by the oil companies represented on it. Starting with four members, each of ten oil companies has now contributed a technologist for active membership on this committee. Every other company represented on TAC has designated a technologist to serve as adviser to this Subcommittee. The men selected for each of these groups have been chosen because of special training, experience, aptitude and interest in this type of work.

Contributor System

The Analytical Subcommittee does not merely draw upon its own membership for information but has been assisted by the technical staffs of other organizations as well. The active membership is systematically aided, in addition to this adviser system, by a contributor system through which non-petroleum organizations that are known to possess information pertinent to the problems on which the Subcommittee is working, cooperate upon request and for specified purposes.

In this manner valuable assistance has been rendered by the Hercules Powder Co., E. I. du Pont de Nemours and Co. (Inc.), United Gas Improvement Co., Universal Oil Products Co., Ethyl Corp., the National Bureau of Standards and others. Through conferences and correspondence with universities and instrument manufacturers, the assistance of specialists in various lines has been obtained. Through common membership on committees of the American Society for Testing Materials, the Rubber Reserve Co., the A.P.I. Research Committees and the Analytical Subcommittee, work has been coordinated and duplication of effort minimized.

The research and development work associated with the problems of increasing production and improving products, as they relate to collection and dissemination of experimental data, is conducted by the Synthesis and Primary Processes Subcommittees. The Analytical Subcommittee attempts to keep these two groups supplied with the necessary analytical procedures to properly conduct and evaluate their work, and by anticipating their problems tries to supply the needed methods of test before the necessity for them has become acute.

The importance of having reliable and accurate methods of analysis to control plant operations in a scientific manner and to evaluate the products produced in those operations, has been increasingly evident during the past several years, particularly with the advent of highly technical processes producing, in many cases, substantially chemically pure products from petroleum. The war emergency has even more clearly emphasized the importance of this auxiliary to production. For several years numerous oil companies have initiated programs of analytical research in their own chemical laboratories and have handled this phase of their work in the progressive manner which it deserves. The TAC was prompt in utilizing the facilities of the oil companies equipped for such work.

Supplies Many Answers

In these times when every facility should be strained to produce its utmost in its contribution to 100-octane aviation gasoline, it requires little explanation to emphasize the importance of accurate analyses. When the quality and quantity of hydrogenated codimer, for example, is so closely related to the degree of conversion, it is imperative that a reliable method be employed in determining the olefin content of the C_4 charge to the polymerization unit. Is the poor clear octane number and the poor lead susceptibility of your hydroformate due to the presence of too much ortho xylene or because the paraffins were inadequately cracked? In the former case you may be handicapped and limited by the nature of your charge stock; in the latter you may be able to effect improvement by altering the operating conditions. Good methods

*Presented before Division of Refining, American Petroleum Institute, Nov. 9, 1943.

**The Texas Co., Beacon, N. Y., Chairman TAC Analytical Subcommittee.

COMMITTEE ROSTER

Members of the Analytical Subcommittee of the Technical Advisory Committee of which Mr. Harry Levin is chairman:

C. E. Headington, The Atlantic Refining Co.
W. N. Axe, Phillips Petroleum Co.
S. S. Kurtz, Jr., Sun Oil Co.
A. E. Miller, Sinclair Refining Co.
W. H. Naylor, Union Oil Co. of California.
E. P. Rittershausen, Socony-Vacuum Oil Co., Inc.
R. F. Robey, Standard Oil Development Co.
F. D. Tuemmler, Shell Development Co.
G. M. Webb, Universal Oil Products Co.

Harry Levin

of analysis can supply your answer.

The crude methods which appeared good enough in other days and for other purposes, won't suffice today. The best methods that anyone has are needed, and the cooperative efforts of the Subcommittees of TAC ferret them out and make them available to all. Frequently, speed in obtaining results is of primary consideration. Thus it is the practice of the Analytical Subcommittee to issue, wherever possible, two methods for making a particular determination. The first is a so-called rapid method, necessarily of limited precision and accuracy, but believed adequate for routine plant control purposes. The second is a precise method believed to be accurate enough for referee purposes.

On specific direction of PAW the methods of analysis developed or assembled by the Analytical Subcommittee are distributed by the committee to hundreds of recipients — oil companies, government representatives and others, who can use them in the war effort. This cooperative endeavor yields information beneficial to even the biggest technical organizations in the petroleum industry, but it is particularly helpful to the numerous small oil companies throughout the country which are unable to maintain research and development organizations of their own.

The Analytical Subcommittee does a great deal of its cooperative work by correspondence to expedite the issuance of procedures and meets in committee at least every two months for discussions not practical by correspondence. It also contributes to other groups engaged in this war effort. Recently it has collaborated and assisted the Isomerization Subcommittee of AGAC in collecting and reviewing the methods of test which it is compiling in the form of a manual for plant operators.

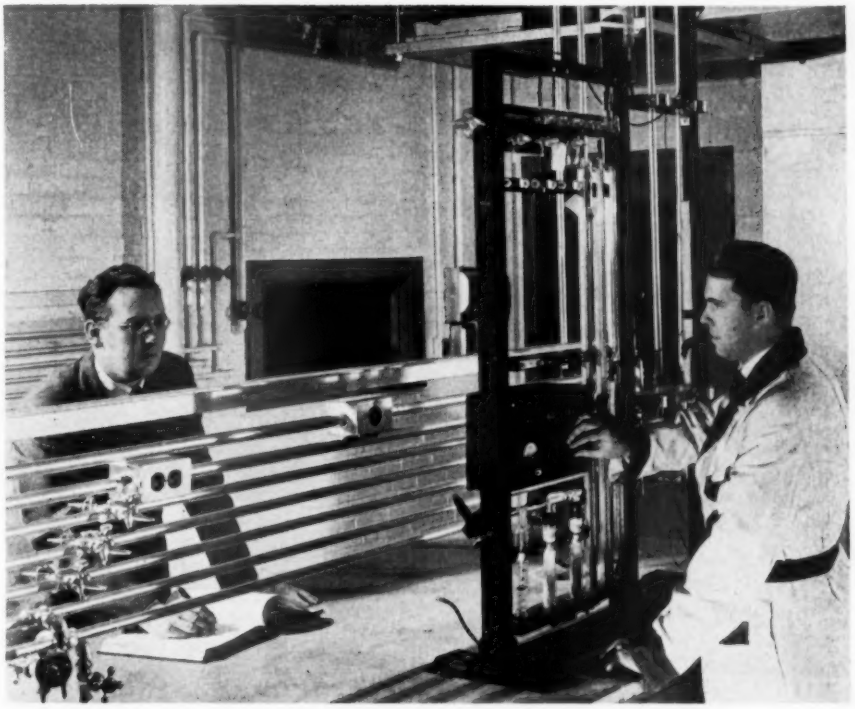
As might be expected from its origin in rubber, many of the methods that have been issued by the Subcommittee concern products of petroleum comprising synthetic rubber, such as butadiene and styrene; and the impurities in such products, such as acetylene, peroxides, etc. With the expanding activities of TAC, more than 30 methods were issued relating to production of aromatics, aviation gasoline, gas stabilization, isomerization, alkylation, butadiene, isobutylene and others, in many cases both rapid and precise procedures being provided.

Some of these methods are entirely new; for example, the bromine-titration procedure which enables you to determine a mere fraction of a per cent of olefins in your normal butane for isomerization. Others are old methods, refined to a point where their usefulness is extended far beyond their original purposes; for example, the weathering test which is a rapid substitute for distillation of saturated hydrocarbon gases. All the methods of test are directed to aid you in your contribution to the war effort.

Methods are being prepared for analysis of hydrocarbons and related substances by ultra-violet absorption spectrophotometry, infra-red absorption spectrophotometry and application of the Raman effect. Since many laboratories are not yet equipped with these modern instrumental methods of analysis, emphasis was first placed on conventional chemical and physical methods as most laboratories possess those facilities. The modern instruments are available in quite a few laboratories already and it is felt that the coordinated effort will be helpful to them by establishing uniform procedures, and by issuing the methods now to the petroleum industry generally, the benefits thereof will continue when the physical instruments become more readily available.

The newer plant processes create new problems for the analytical chemist. Though a difference of 5°F in the result for end point of motor gasoline was within the accepted tolerance of the established method of test, the operators on toluene units now are disturbed by 2°F differences. Whereas slight difference in olefin or diolefin content still left you with a product that could be sold and would run your car, it may now leave you with a batch of toluene entirely unacceptable, requiring retreating or rerunning before disposal.

The best possible analytical methods are absolutely necessary to insure the proper application of the newer operating techniques and the proper utilization of the more fully developed older operations. Any assistance which you or anyone in your organization can render to the Analytical Subcommittee will be most gratefully received. Your analytical chemist is truly on the spot and the Analytical Subcommittee of TAC is doing all within its power to provide him with the methods he needs, so it will at least occasionally be the glamour of the spotlight, instead of the "hot shot."



The Podbielniak fractional distillation apparatus is illustrative of the intricate type of laboratory equipment used by the analytical chemist

REFINING HIGH SULFUR CRUDES

Requirements in Corrosion Resisting Equipment and Operating and Treating Methods are Described from the Successful Experience of a Large Refinery in the Middle West.

THERE is nothing complicated in refining satisfactory products from the so-called "sour" crudes, state engineers and operators of Shell Oil Co.'s Wood River, Ill., refinery. They list the essential plant requirements as:

1—Installing corrosion-resistant alloys in critical temperature zones.

2—Making frequent careful inspections at regular intervals, and replacing indicated unsafe equipment.

3—Providing the necessary treating units for reducing sulfur to specification levels in the refined products.

The Wood River refinery has long been processing both "sour" and "sweet" crudes. Currently, most of the high sulfur crudes (a term preferable to "sour") come to the refinery by pipeline from West Texas. This crude, as received, contains about 1.5% sulfur and around 100 lbs. of salt per 1000 bbls. Prior to pipelining, the water is settled—no use pumping water a thousand miles for disposal.

When the crude reaches the refinery, it is run into storage tanks, some cone-roofed and others equipped with floating roofs. These tanks, of low-carbon steel, are not of unusual construction and are not "protected" in any way, and their damage through corrosion is not considered exceptional.

Salt content is reduced to the maximum economical extent before refining. The incoming crude is intimately mixed with water and the salt removed by a washing operation. Occasionally it has been found necessary to add emulsion breakers to effect sharp separation.

Technologists admit a sulfur-removal process for pre-refining treatment would be desirable, but so far there is no generally accepted practical process.

Topping Operations

All crude is first topped. Topping units handling high sulfur or semi-high sulfur crudes have low-carbon steel furnace tubes. No special alloys to resist corrosion are economically justified, according to plant experience. Overhead from the topping stills is charged to a fractionator system which takes off, in effect, three streams: pentanes and lighter, straight-run gasoline, and fuel distillates. The former two contain appreciable quantities of H_2S. Bottoms from the still constitute cracking stock.

Pentanes and lighter go directly through suitable pressure surge tanks to the plant stabilizing system, where the uncondensables, methane, ethane and hydrogen sulfide, are taken overhead to supply the refinery fuel gas system. Propane, butanes and pentanes also are separated here and run to storage for further processing or sale. Propane is treated with tri-potassium phosphate for removal of any remaining hydrogen sulfide. C_4's and C_5's do not contain this impurity and, after further processing, are used in making 100-octane aviation gasoline components, or other war products.

The gasoline fraction is caustic scrubbed for H_2S removal, then run to storage for further processing. Distillate fractions, which may be Nos. 1, 2 or 3 fuels, depending on topping operation, also are run to storage for further processing to improve quality.

Where temperatures range from 575° to 800°F. in equipment, severe corrosion may be expected when sulfur compounds are present. Maximum tower temperatures in this plant range from 630-650°F. at the bottom. That part of fractionators where this temperature range exists is protected either with linings of a ceramic (such as brick, gunite, etc.) or with 11-13% chrome alloy (semi-stainless) steel. Trays generally are conventional low-carbon steel or cast iron construction. Vessels may be purchased ready-lined, or alloy lining may be installed. Ceramic linings also are conventionally attached.

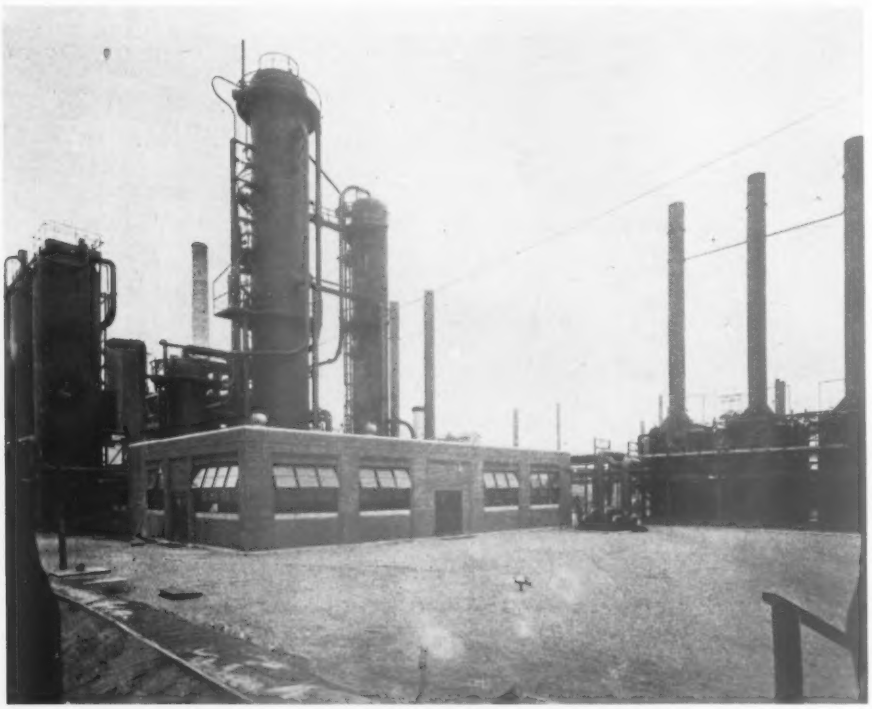
Condensers used have Admiralty metal tubes and low-carbon steel shells. Since steam is injected during topping, sufficient anhydrous ammonia gas is injected to reduce corrosion. Amount of ammonia used is controlled by maintaining pH of aqueous condensate from 8 to 8.2 as determined through periodic examination. Care should be taken, operators caution, not to exceed 8.2 pH, as otherwise the excess ammonia may attack the alloy tubes.

Cracking Operations

For cracking, this plant is equipped with thermal cracking units containing chrome alloy tubes. Two fluid-catalyst cracking units are now under construction. Both types have been extensively described in the literature.

Existing units are equipped with both 4-6% and 8-10% chromium alloy tubes. The 4-6% alloy gives adequate corrosion protection, it is stated, while the 8-10% alloy is used more for its structural strength under high temperature-pressure conditions than to withstand corrosion. Admittedly, however, the latter's corrosion resistance is greater. Operating conditions are around 1000°F. and 1000 lbs. per sq. in.

Transfer lines to much of the auxiliary equipment, flash chambers, soakers, fractionators, hot oil pumps, etc. are 4-6% chrome alloy. The criteria are two: temperature of corrosive product, and operating temperature and pressure, in the equipment. If temperature is in the



A high-sulfur crude topping unit at Shell's Wood River refinery. Left to right, crude desalter battery, gas-oil stripper fractionating columns and tube furnaces; building in foreground is pumphouse

Don't get left

Refiners who put off their post-war planning too long are likely to be left at the post—or at least, not to be in at the finish

CATALYTIC CRACKING
REFORMING
HYDROGENATION
ALKYLATION
ISOMERIZATION
THERMAL CRACKING
HYDROFORMING
DEHYDROGENATION
POLYMERIZATION
UNISOL TREATING
RETREATING
POLYTREATING
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CARE FOR YOUR CAR FOR YOUR COUNTRY
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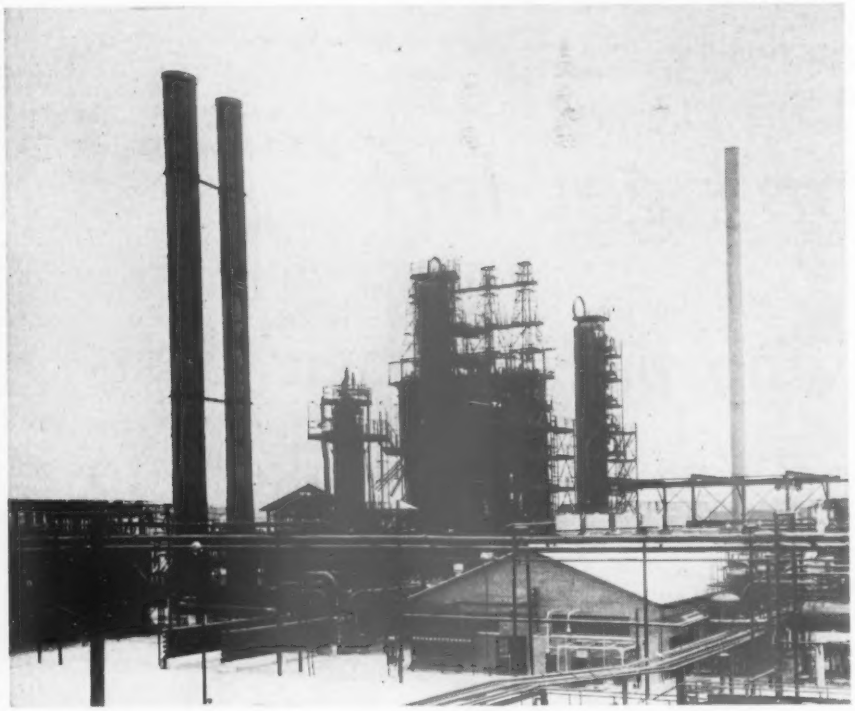

View of a cracking unit at Shell refinery, operating on high-sulfur crude. Left to right, cracking furnace and stacks, alloy-lined fractionating columns, pumphouse and products accumulators. Heat exchangers are visible in center foreground

critical corrosion zone, alloy is used for protection from corrosive products; otherwise, the alloy is used for its structural qualities alone where high temperatures and pressures are involved.

Most pumps handling a corrosive product whose temperature is in the critical zone, 575-800°F., have 4-6% chrome alloy blocks or cases, with appropriately protected moving parts. Practically all auxiliary vessels are lined with 11-13% chrome alloy liners. Fractionators have alloy trays in the critical corrosion temperature area, although here again thick cast iron construction can be used with adequate inspection to indicate necessity for replacement. Use of cast iron in this service is growing more extensive now that alloy steels are difficult to obtain.

Lime or other alkaline agents may be used to reduce corrosion in tubes and connecting lines. The amount injected depends on experience. However, if residuum is to be coked for metallurgical use, such agents must be avoided.

Condensers, just as in topping units, are connected to fractionators by low-carbon steel lines. Condenser tubes are Admiralty metal, and the shells are low-carbon steel. Ammonia is seldom used here because this is a "dry" distillation.

Products from cracking include light gases, gasoline, some overhead fuels and residual fuels or coke. Gases from the unit are delivered to the absorption plant, and the gasoline to stabilizers.

In the stabilizers, most of the hydrogen sulfide and part of the light mercaptans are stripped out and charged to the plant fuel gas system. As in topping, propane, butanes and pentanes are segregated; propane is K_3PO_4 treated and all are run to storage for further processing or sale. Cracked gasoline is sweetened by the "Solutizer" process or by conventional doctor treatment. Any cracked fuels made, which depend on severity of cracking, are similarly charged to storage for further processing to improve quality. Residuum may be sold as industrial fuel or coked; in this latter case additional cracked gasoline and gases are produced and treated as before.

Great emphasis is laid by plant technologists on careful periodic inspections. Shell's operations are predicated on definite run periods with necessity for off-schedule shutdowns avoided by inspection records and recommended replacements. Operators know, for instance, that in certain units specified fractionator trays, caps, etc., must be replaced within a definite period in 1944. Experience and accurate inspection records indicate these parts will then have been sufficiently attacked by corrosion to require renewal.

At inspection during every shutdown period, certain vessels are entered, hammered and calipered. Scheduled lines are checked, pumps examined painstakingly. Thus, rates of corrosion for every part of the plant are determined in terms of operating conditions. From this information, replacements are scheduled and necessary parts placed on order accordingly.

Certain West Texas crudes may be used for manufacture of motor lubricants. The unsuitability of others in general is predicated, not entirely on sulfur content, but on the viscosity, gravity relationships and wax content of the individual crudes. To make a stable lubricant, it is necessary for the paraffinic, naphthenic, and other aromatic components to have a definite relationship with one another; a satisfactory viscosity index must be obtained as well as pour and cloud points, flash and fire, etc. The only way to determine the suitability of a crude is for the individual refinery to make a pilot plant run and test the products obtained to insure they are of the desired specifications.

Safety Precautions

Safety precautions for personnel are not complicated, despite the toxic character of some high sulfur crudes and some product vapors. In the first place, vapors and liquids are maintained in closed systems until sulfur compounds have been either stripped at stabilizers, removed by caustic scrubbing or the product sweetened. Spent caustic containing sulfides is mixed with its neutralization equivalent of spent treating acid. A dual disposal problem is thus solved in the resulting neutral salts, because low-pressure H_2S evolved is burned under operating furnaces, while the dissolved salts go to plant sewers after passing a separator box which removes any hydrocarbon liquids for reprocessing.

Care is observed to avoid leaks, this is a part of the regular inspection program. When tanks which contain H_2S are gauged, gaugers must wear masks.

No vessels, tanks, or otherwise, may be entered until they have been pumped out, purged with steam, washed with water, and OK'ed by the safety department. This department is equipped with all the necessary devices for testing the air and any suspicious deposits within the vessel. Deposits determined to be pyrophoric iron sulfide are kept wet until removed to a safe place. Should the Safety Department so decide, the men wear fresh-air masks; ordinarily, they are not allowed to enter a vessel until the air inside is safe without masks.

In treating, a great saving in chemicals cost is made by stabilizing and stripping light products. H_2S is removed, together with light mercaptans, methane and ethane. This mixture augments the fuel gas supply. Tri-potassium phosphate employed in removing H_2S from propane is regenerated; the process developed by Shell is extensively described in the literature. Caustic scrubbing removes much of the harmful light sulfur compounds from cracked and straight-run gasolines while sweetening, or any of the several catalytic desulfurizing processes, handles the remainder. Shell, of course, uses its "Solutizer" sweetening process extensively.

Treatment for quality improvement of gasoline and fuels, aside from that for sulfur control, is as conventional as in most plants.

LUBRICATING GREASES GONE TO WAR

Work of Manufacturers is Now Directed to Supplying Improved Products to Meet the Severe Conditions of Field Service; Research on More Accurate Test Methods Has Been Stimulated.

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By D. P. Thornton, Jr.

LUBRICATING greases gone to war was the theme of the 11th annual meeting of the National Lubricating Grease Institute at Chicago's Edgewater Beach Hotel, Nov. 1-3.

Military authorities in charge of servicing of ground vehicles and aircraft in the field discussed the severe requirements imposed on the lubricants. Not only must they function under extreme conditions, but the proper equipment for dispensing and applying them is often absent and the servicing by necessity hurried and done under strain.

The number of types of fittings and greasing apparatus has been reduced and servicing equipment is still undergoing improvement. It was suggested that the grease manufacturers work toward supplying an all-purpose lubricant in the fewest possible number of grades necessary.

Wartime and other emergency demands, however, have not restricted the research work in further improving lubricating greases and in developing methods of tests that more faithfully indicate the performance characteristics of the lubricant. Technologists with the military branches have made contributions to the latter subject from their own experiments. The reports from the various technical committees of the association reflected the amount of research work carried on in the laboratories of the grease manufacturing companies.

Ordnance Problems

"Lubricating Grease in Ordnance", a very informative paper presented by Lt. Col. C. E. Cummings, Ordnance Dept., Tank-Automotive Center, Washington, discussed greasing problems encountered in the field. His remarks were limited to automotive equipment of all types in ground service, although lubrication problems occur with much other equipment, he said.

Lubrication is an essential element, the speaker pointed out, and must be fitted to the various requirements of the equipment while at the same time using as few grades of grease as possible, as well as types of grease dispensers.

Explaining some of the difficulties encountered, Col. Cummings said: "The infantryman must lubricate his own guns; the tank crew has no service station. Successful training requires a well-defined routine which will automatically free the man in the field to use his mind to meet the exigencies of the moment rather than the technical details of servicing his guns, tanks, and trucks". Manuals for maintenance, surprisingly enough, are religiously followed by the man in the field, he said. Sometimes it has been found that the manual has rules which, under specific circumstances, are unnecessary or cumbersome; nevertheless, the regulations are followed.

Maintenance in the field is done under the echelon system, it was explained, the first two echelon units (a function of each company) bearing the brunt of the work. The first echelon is strictly preventive maintenance by equipment users, plus minor repairs which can be effected without precision tools and with other than shop equipment. The second echelon covers maintenance occurring monthly and is merely more detailed than first echelon duties. The work is done by the company mechanics' crew in the field. Also included in the second echelon is still more detailed semi-annual maintenance, including adjustments, by the battalion mechanic.

The third echelon is on a divisional basis and includes light maintenance in which the vehicle is overhauled and major readjustments of working parts conducted as necessary. Occasionally the third echelon will be called on for certain types of heavier overhauls, in which case some major repairs may be made.

Two papers presented at the meeting of the National Lubricating Grease Institute are published in this issue; "Some Popular Misconceptions about Lubricating Grease", by F. L. Koethen, and "Lubricating Grease Requirements for Modern Military Aircraft", by E. R. Irwin and Capt. S. C. Britton. Other papers will appear in later issues.

The fourth echelon is a semimobile repair shop, where considerable heavy maintenance work always is done. This repair shop may be quite near the "front" and always is well within the theatre of operations.

The fifth is the motor base, always located conveniently to, but outside of the theatre of operations. Here a unit may get a complete rebuilding, as well as having any ordinary repairs made. Where, in the lower echelons, an ailing engine may be removed and a replacement substituted, the fifth will tear the engine down for a complete workover, returning it in "as new" condition. The work here is comparable to a factory rebuild job.

Since the brunt of the servicing work falls on the first and second echelons, by men whose prime function is to fight rather than be mechanics, it is essential that the equipment they work on and with be simply designed and easily serviced, with a minimum of servicing apparatus required. In this connection, Col. Cummings remarked that less than a year ago six types of grease fittings were in common use as a result of hasty conversion of equipment from peacetime to ordnance construction. Some vehicles had three different types of fittings side-by-side, requiring constant use of adapters on greasing apparatus. Now there is but one, admittedly a compromise.

Formerly, as many as 35 different types of greasing apparatus were necessary for the work involved; now there are but a few, specialized for the echelon which uses them. These vary from the standard lever-type hand gun operating to 8000 lbs. per sq. in. pressure and holding 1 lb. of grease per filling, to the large guns of the semimobile shop and the motor base.

Similarly, the problem of equipping a mobile unit for battle conditions was discussed. At first, a 1½-ton, 4 x 4 truck was used, equipped with greasing apparatus, necessary grease, battery charger, and other servicing devices. This was intended to move down a line of vehicles in the field, servicing each in turn. This was discarded after trial because, it was explained, the equipment was too big, and seldom was it practical to line vehicles up for maintenance operations under battle conditions, thus inviting an enemy attack. The modification was a more compact design mounted on a trailer.

Barium Greases

"Barium Greases" by L. W. McLennan, Los Angeles, Union Oil Co., dealt with a new type grease which has been under development and trial for some time. Greases made from barium soaps, the speaker said, come nearest to an ideal all-purpose grease of any yet developed. Tests indicate it can be used successfully for chassis, water pump, motor bearing and wheel bearing applications, under both high and low temperature conditions, and at high or low rates of shear, it was stated.

The base is made (sample method) by adding excess barium hydrate to prime tallow and heating to 214° F. in a steam

NLGI jacketed kettle to permit complete saponification. One-third of the desired amount of lubricating oil is then added, which, reacting with some of remaining barium hydrate, drives the temperature up to 375° F. by heat of reaction. The product is held at this temperature by cooling water circulating in the jacketed kettle. After reaction ceases, balance of the oil is added and the kettle contents are cooled to 210° F. The proper amount of water then is added, the resulting grease being worked to a smooth consistency. The water content is not critical, sufficient being added to keep the melting point high, but at same time giving good appearance and consistency to the product.

No new equipment is required to make this grease, it was said, all that is necessary being a steam-jacketed kettle with an appropriate agitator. Analytical procedure is the same as for other products. Tallow, lard oil, cottonseed oil among others may be successfully employed in the base stock or the fatty acids themselves, as desired. Barium hydroxide concentration ranges from 40 to 60%. The type and viscosity of the mineral oil has a wide range, depending specifically on what properties are desired in the finished grease. The final product looks like a calcium-soap grease.

Illustrating barium grease characteristics, Mr. McLennan said the milled grease is particularly effective in bearings, as it does not break down, is non-fibrous and its water and temperature resistance are high. It thins out under heat about the same as calcium and sodium-soap greases. Oxidation resistance also is high, showing a 96-hour induction period without inhibitor in the Norma-Hoffmann Oxidation Test. Its appearance after test is slightly darker and the grease is somewhat harder, but no other changes are apparent.

Applications Cited

Several successful applications, taken at random from company records, were presented. One was as a sealed-in lubricant on the rollers of drilling line anti-whipping or line-saving devices. The manufacturer's test was to run the lubricated roller to failure by high-speed belt-drive from an electric motor. While other lubricants permitted failure of the roller long before the electric motor gave out, rollers lubricated with the barium grease outlasted numerous belts and two motors.

Another application was on the conveyor cradles bearing hot slabs of blister copper through cooling water. Best grease formerly applied had to be replaced twice each 24 hours because of the high temperature and immersion in 210° F. water. The barium grease, however, only had to be replaced every 4 days. Other applications given included a conveyor belt having 85,000 bearings, operating under temperatures ranging from 10° to 130° F., plus heavy rainfall and excessive quantities of dust and grit. Numerous other industrial applications were cited.

Technical Committees Meet

Scattered throughout the 3-day meeting of the grease manufacturers' association were reports of the various subcommittees of the technical committee. At a meeting of the whole committee a number of pressing technical problems facing the grease manufacturers were discussed. Among them were:

A suggestion that manufacturers of grease guns and auxiliary equipment show a rating on their product which will indicate the heaviest grease it can efficiently dispense at a given temperature. Several industrial users pointed out their experience of having to buy grease to fit dispensing apparatus in place of buying dispensing equipment to handle the required lubricant. A committee is to contact manufacturers for information on grease dispensing ability of their equipment with which to draw up plans for an N.L.G.I. rating.

Consideration of the automobile manufacturers' request that automotive grease classifications be set up, similar to S.A.E. number for motor oils, drew lengthy discussion. A suggestion that the present Army classifications be used drew fire on the ground that these exist largely because of necessity and are not the most suitable which can be developed. It was also pointed out that automotive requirements change with changing models and that greases change with increasing knowledge, the whole matter being in such a state of flux that a classification might quickly become obsolete.

New Tests Described

Results were presented of a co-operative test using the light weight (30-gram) cone for determination of grease consistency. The discussion revealed favorable opinion of the method described elsewhere in this article. The committee agreed to recommend that A.S.T.M. consider the 30-gram cone as a method supplementary to that using the now-standard 150-gram cone.

The present A.S.T.M. method for determination of free acid and alkali was discussed in the light of subcommittee findings (also reported elsewhere in this article). It was recommended that the new proposed method be further examined in co-operative tests and that, upon a favorable report, appropriate recommendations be made to A.S.T.M. requesting consideration by A.S.T.M. Committee D-2 as a revised standard method.

The present A.S.T.M. insoluble impurities test method was not considered entirely accurate by the committee in that, when the grease is broken down by hydrochloric acid, some insoluble impurities in the grease are converted to soluble chlorides and missed; also in naphtha solutions, asphaltics and waxes are not dissolved. The real problem in the test is the separate determination of organic and inorganic soluble matter. The group voted to appoint an exploratory subcommittee to survey and report possible new methods.

Dropping Point Methods

An informative report in grease dropping point methods was given by J. C. Zimmer, Standard Oil Development Co., Elizabeth, N. J. He pointed out the difficulties of determination and interpretation of results inherent in the present A.S.T.M. dropping point methods, because greases have no true melting point. With the present method, he said, it has been found that certain greases having dropping points in excess of 400° F. tend to stick in the cup, giving erratic or no data. Trouble also has been experienced in placing very fibrous greases (soda base) in the test cup, giving rise to the suggestion that means be provided more exactly to control the distance the thermometer can be inserted in the cup to insure greater reproducibility.

Because of the limitation in the test that results "should not be considered as having any bearing upon service performance", it was suggested that the value obtained be used only as a very qualitative indication of resistance of greases to heat, in distinguishing conventional lime-base cup-grease from high-melting point types, for example.

The report stated a preliminary investigation has been made of the so-called "aluminum block" test. This consists of an aluminum block, internally heated by electrical resistance bars and having ⅛ in. x 4 in. channels connected to a ⅛ in. x ½ in. circular reservoir cut in the face of the block. The test sample is placed in the reservoir, smoothed flush with the block face, and block temperature raised at a uniform rate. Temperature at which any oil separates and runs down the channel is noted, also that at which the grease has moved a given distance down the channel. Correlation with service performance is yet to be made for evaluating significance of the test.

Pressure Viscosimeter Modified

To acquire information on the resistance to flow of a grease under loads greater than gravity, considered an important point which may aid in predicting performance, the S.O.D. (Standard Oil Development) Pressure Viscosimeter reported in a paper last year was modified to permit measurements over a range of elevated temperatures. The apparatus consists of a motor, gear box, Zenith pump, cylinder and capillary, the latter two to be enclosed in an oven for temperature control. Since flow rate is maintained constant through the capillary, pressure on the grease is the only additional information required to

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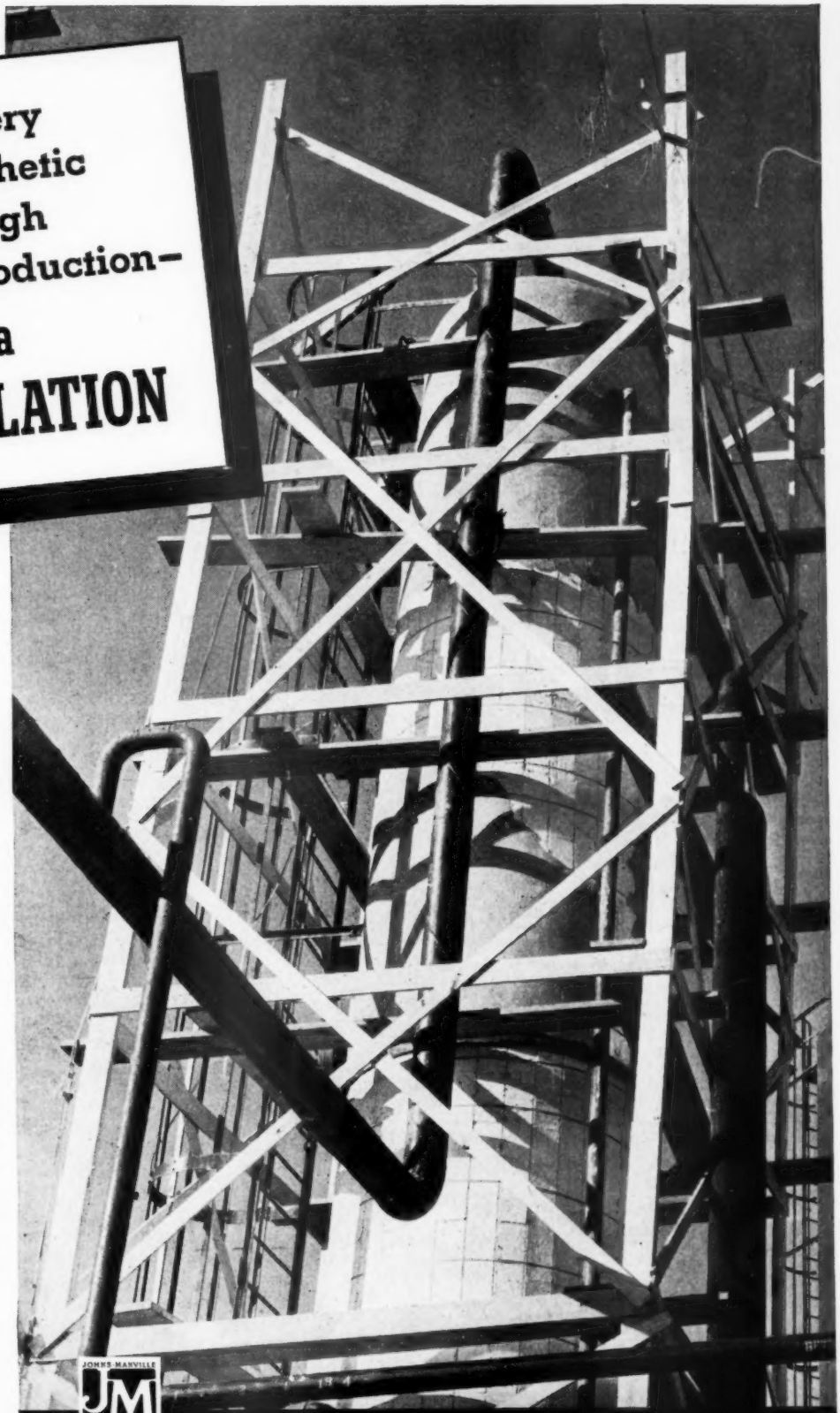

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determine apparent viscosities. Through test conditions, viscosity is proportional to pressure, which permits plotting pressure vs. temperature to secure essentially a viscosity-temperature diagram of the grease.

A number of greases have been tested with the modified apparatus, it was reported. The data on variation of viscosity with temperature indicated this type of test offers promise as means of estimating performance of several types of greases at elevated temperatures. However, a great deal of additional work must be done in correlating viscosity-temperature data with service experience, the subcommittee cautioned as well as suggested that the grease be "worked" through the gear-box in subsequent investigations to simulate conditions existing in an actual bearing.

Penetrometer Cone Modified

Report of light-weight penetrometer cone standardization tests was given by H. L. Moir, Chicago, Pure Oil Co. This modification of the standard 150-gram cone was suggested for measuring the consistency of semifluid greases with cones weighing 150, 50, 30, and 25 grams, respectively. Remarkably good correlation was obtained on results from the various laboratories co-operating in the work, the report stated. The data showed that, if values deviating the greatest from the mean are eliminated, then the average of data from those laboratories submitting results are within ±3% of the grand average for all. The A.S.T.M. test requires only a 3% maximum allowable deviation for check readings on a specific sample in a single laboratory, with no requirements for agreement between different laboratories. This gives support to the belief that the wider deviations from mean shown by data from a few laboratories is due to the difference in the apparatus, which admittedly are not precision instruments, rather than a criticism of the method.

Limitations of the instrument for testing purposes were suggested as: (1) nonfluid greases, 0 to 385 penetration using the 150-gram cone, (2) semi-fluid greases, 270 to 385 penetration using the 30-gram cone, and (3) fluid greases, penetration type of test not suitable. For the latter, the subcommittee is in hopes the S.O.D. Pressure Viscosimeter can be used in evaluating this type of grease.

The subcommittee further presented a proposed N.L.G.I. classification of semifluid greases on basis of worked consistency with the 30-gram cone modification of the A.S.T.M. penetration test. It proposes, briefly, 4 classes: F-4, penetration of 270-300; F-3, penetration 300-330; F-2, 330-360, and F-1, 360-385. Classification is based solely on consistency of sample and "is not intended to evaluate factors of apparent viscosity, type of soap, mineral oil constituent or quality".

A committee report on test methods for determining free acid and alkali in greases was read by Gus Kaufman, Beacon, N. Y., The Texas Co. The report states in part:

"An accurate estimation of co-existent free alkali and free acid is a significant aid in the control of manufacture of lubricating greases, allowing the manufacturer to limit these constituents to desired ranges which are important in certain cases for the establishment of desired grease structures, melting point ranges, and the like. With such a method, the rate of saponification of products such as cold set greases made from organic acids and strong bases can be followed.

"The accurate determination of free acid and free alkali is also important in analysis of used or deliberately oxidized greases. For instance, it has been found that the high temperature decomposition of a sodium soap grease under heavy service may result in the build-up of co-existent free carbonate and free acidity in amounts of 1-2%. The analysis of high free alkali greases after the Norma-Hoffmann Oxidation Test affords an example of how increase in free acidity may be checked against changes in the free alkali content of the grease if desired.

Effect of Free Alkali

"Because of the variety and complexity of present day grease formulas it is difficult to make a valid generalization as to the effect of free alkali. It is the subcommittee's feeling that arbitrary specifications on such constituents be discouraged, and that greases be evaluated by practical tests as far as possible. Further work should be done on the possible abrasion characteristics of large amounts of free alkali.

"Here again it is difficult to generalize on the effect of free acidity on the performance properties of greases. For instance, greases on long-time service may develop as much as 5% free fatty acids as oleic without causing bearing corrosion or unsatisfactory lubrication. Amounts of free acid of the order of 1% are commonly found in present day lithium base greases without apparent harm to bearings.

"It is recommended that N.L.G.I. seek to educate the public to judge greases by performance tests rather than by composition specifications; in other words, free alkali and free acid should be considered not as harmful impurities but as controlled additives incorporated to improve performance in many cases."

The subcommittee's report indicates that present A.S.T.M. test methods, at maximum effectiveness, determine only the excess of one constituent (free acid or alkali) over the other, and, in addition, the requirements of the present test (D 128-40) are such that if greases show an initially acid reaction, they are not analyzed for free alkali. Since it has been shown by several investigators that free acid and free alkali may be co-existent in a given grease, usually as sodium or calcium carbonate and free fatty acid, and since the subcommittee shows the present method misses carbonate unless calcium hydroxide is simultaneously present—because of analytical procedure—it is considered that a more informational method of test be developed.

Accordingly the committee has recommended for consideration a method which has been in extensive use by The Texas Co. for the past several years. The method consists of the direct titration of free acidity with 0.1N alcoholic potassium hydroxide to phenolphthalein end-point, having first disintegrated the sample with a 50-50 solution of benzene and isopropyl alcohol. Benzene is used for its enhanced solvent powers and because it is less a fire hazard than naphtha; substantially anhydrous isopropyl alcohol (2% water maximum) minimizes tendency for interaction of sodium or calcium carbonate and free fatty acids when both are present in a grease.

The neutralized solution from this titration is then refluxed for 10 minutes with an excess of 0.5N aqueous hydrochloric acid, adding anhydrous isopropyl alcohol to secure one-phase solution, then titrating the excess acid with 0.5N alcoholic potassium hydroxide to phenolphthalein end-point.

Free acid is expressed in terms of oleic acid; free alkali in terms of the alkali metal or earth as the carbonate. This last is because the hydroxide is rarely present in the commercial kettle-made products as they reach the laboratory and because the hydroxide, if present, changes over to the carbonate on storage or in service.

Method Has Limitations

Neither the present nor the proposed method is suitable for determination of free acidity or alkalinity in greases made from aluminum, zinc, tin, lead, barium, magnesium, and triethanolamine. This is because they are amphoteric, displaced by the strong base used, or too weak in alcohol to affect phenolphthalein. Free "alkalinity" in these soaps is not considered significant because the oxides, carbonates, and hydroxides of the weak bases are commonly not considered alkaline in the usual sense; their presence and extent may be determined as insoluble residues with usual solvent extraction methods.

Among the several other papers of interest was a discussion of the results of advisory consultations with the Treasury Procurement Division with regard to specifications for grease and gear lubricants, by C. M. Larson, Sinclair Refining Co., New York; testing extreme pressure greases by R. C. Adams, Navy Experiment Station, Annapolis; technical aspects involved in launching lubricants by C. W. Bohmer, Standard Oil Co. of New Jersey; and developments in joint committee work of N.L.G.I. and bearing engineers by T. G. Roehner, Socony-Vacuum Oil Co., New York.

Some Popular Misconceptions About Lubricating Grease*

By F. L. Koethen**

Some of the common erroneous misconceptions of industrial grease consumers with regard to the desired characteristics of the product are discussed. Their inclusion in specifications, it is contended, may force the manufacturer to supply a product which is not best suited for the required service and at the same time increases the cost of manufacturing it. In the case of the standard tests, the correct interpretation is important for the guidance of all who buy grease or write the specifications for their purchase.

ONE of the functions of the National Lubricating Grease Institute should be to present to industry, those who use grease and especially those concerned with writing the specifications of large purchasing organizations, the true facts concerning their products. These persons naturally look to our association for such information.

That there is a need for dissemination of this information is evidenced by the fact that many existing specifications contain clauses whose very presence shows that the writers held, to a greater or less degree, conceptions as to the functions of greases and their proper composition which are open to question.

This paper is presented, not in criticism of any individuals or groups but for the purpose of emphasizing important facts concerning the composition and use of grease, and in the hope of being helpful. Perhaps it can serve as a guide towards the attitude our members should take in their contacts with the public, to the end that the status of the grease industry will be improved.

Many of the statements which follow are old and almost axiomatic to the experienced grease maker, yet it is apparent that they need to be given more emphasis. On the other hand, the writer may be mistaken in a statement here and there, in which case a free and thorough discussion is in order.

The following statements should be emphasized to those who use or buy grease lubricants:

1. Soap is a desirable, not an undesirable, component of grease.
2. There is no advantage to the user in stipulating that the percentage of oil in a given grease should exceed any certain figure.
3. The percentage of ash resulting from the combustion of a grease is not in itself an indication of quality. It should be superseded by a limitation of the percentage of uncombined mineral matter.
4. There is no necessity for limiting the percentage of water in a calcium soap grease; it is only the uncombined water which should be restricted.
5. Although excessive sweating of free oil from a grease is obviously bad, it does not follow that the best grease is the one which sweats oil the least.
6. A determination of dropping point or melting point does not indicate that a given grease may be safely used at or near this temperature.
7. The lubricating ability of a grease is not limited by that of the oil from which it was made.

Soap a Desired Component

The belief that soap is not a good thing in a lubricating grease and that it would be better to make "pure mineral" greases without soap, still seems to be latent in some persons' minds, although soap greases are now generally accepted as standard and as being much superior to pure mineral greases. The latter term can include only petrolatum, paraffin wax and asphalts.

The fear that soap will separate out and cause gumming is a natural one to a person with a hard cake of washing soap in mind as a typical soap, whereas in reality the soaps in greases are present as jellies, much different from regular washing soap. The nomenclature is unfortunate, but it survives because it is much more convenient to say "soap" than "the fatty acid esters of alkali metals".

The important safeguard against trouble from the use of soap lies in the proper selection of the type of soap to fit the conditions of usage and, of course, proper manufacture. The manufacturing procedures which are customary at present in the greasemaking industry are such that troubles in service due to the presence of soap are negligible.

As to the amount of soap, the presence in a specification of limits for the A.S.T.M. penetration of the worked grease will give sufficient control. The percentage of soap for a given consistency does vary to a certain extent with the nature of the fat used, but in general, too little soap will make too soft a grease, too much will make it too stiff and too expensive to manufacture.

It is conceivable that, by special manipulation of the cooling conditions, a grease could be made to the prescribed worked consistency with so little soap as to give definitely poor service in one way or another, but the writer knows of no such case outside of a laboratory.

We thus conclude that no advantage is gained by excluding the presence of soap or limiting the range of percentage used.

Oil Content

There is no advantage in stipulating the minimum percentage of oil in a given grease. This follows as a natural conclusion from the foregoing paragraph. It must be stated definitely, however, because many specifications, both government and industrial, still carry this limitation. The requirements that the grease be of a given consistency, well made and free from fillers (all included in these same specifications) give ample assurance of the quality and suitability, but many a good grease fails to pass the specifications because the oil content is 1 or 2% low.

Ash Determination

The A.S.T.M. procedure (D-128-40) clearly states that an ash determination should not in general be regarded as of any great importance, but the method still occupies a prominent position and, because no better criterion is presented, it is frequently called for. What the user of any grease really needs to know is how much gritty matter is present in the grease, not how much calcium or sodium oxide was combined with fat to make the soap jelly.

The solution of the grease in a solvent which does not react with the mineral matter (such as Stoddard solvent containing 10% butyl cellosolve or a hot benzol-alcohol mixture) followed by filtering in a Gooch crucible, will reveal the presence of undue amounts of unreacted lime, mineral impurities and all other non-lubricating solids. (If graphite is present, it can be removed by ignition of the residue on the filter.) The A.S.T.M. method for fillers, in which the grease is broken up with hydrochloric acid, does not show the presence of minerals soluble in acid, such as calcium carbonate (whiting or unburned lime). The Navy count of the dark specks visible in a sample on a microscope stage sometimes may report soft, harmless bodies as dirt, implied by the specifications to be harmful.

Water

Water in a calcium soap grease need not be restricted to as low a figure as is frequently written. Two and one-half to 3% water thoroughly combined does no harm, in fact serves as a combining agent; it does not cause rusting because the water is the internal phase of a complex emulsion, each droplet surrounded by oil. Uncombined water which can be seen on a microscope slide is really harmful because each drop forms a weak spot in the lubricating film and any water which is not properly emulsified

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*Presented before National Lubricating Grease Institute, Chicago, Nov. 1, 1943.

** Consulting Industrial Chemist

NLGI might contact the metal and cause rusting.

For these reasons, it is suggested that limits up to "3% water with no visible uncombined water" be permitted.

Oil Sweating (Separation)

Methods of testing for the amount of oil which might separate from a grease in service have largely been based on the heating of a sample of grease in a perforated or wire-gauze cone. Since this test was introduced, there has been developed a tendency in the more lately issued specifications to increase the prescribed temperature in order to accelerate the test and to make it more severe. Variations of these test methods were discussed by Carl Georgi[1], chairman of the Technical Committee, at the previous N.L.G.I. meeting. His tests showed, among other things, that at elevated temperatures all greases made from low viscosity oils showed too much sweating. Too high a test temperature hence might require a grease maker to use an oil which is too viscous for the conditions of service.

All lubricating greases should sweat a little free oil, to enable them to creep into narrow clearances by capillary action. All satisfactory greases now in service do sweat a little oil. It is not correct to assume that the grease which passes the most severe sweating test will give the best lubrication.

The cone test in some cases gives misleading results because some greases change their structure at elevated temperatures (aluminum soaps at about 160° F. for instance). Also, calcium soap greases lose water and separate at 160° F. in the cone, yet are satisfactory greases for the services recommended or for storage even in hot climates. Calcium soap greases are not recommended for use in conditions where outside sources of heat produce such temperatures.

Greases which are recommended for use at elevated temperatures will give valuable information if cone-tested at these temperatures, but for calcium or aluminum soap greases, the 160° cone test is misleading.

Dropping Point in Relation to Temperature of Use

The ideal melting point determination would perhaps be one which gave a figure which could be used as a positive guide to the maximum safe operating temperature in service. Unfortunately, other factors such as surface speed, bearing clearance, time, and tightness of seal which affects the relative area of vapor disengaging surface, have an important bearing on how much heat a grease can withstand.

In service, sufficient softening may occur below the stated temperature to cause trouble. On the other hand, where seals are tight and other conditions favorable, certain sodium soap greases have been used successfully above their "melting point".

In the case of calcium soap greases, the drying action of a combination of temperature and time produces trouble which would not be expected from consideration of the temperature alone. Hence, if a No. 3 cup grease gives trouble due to the unavoidable heat surrounding a bearing, no advantage is gained by calling for a No. 5 grease, which has a distinctly higher dropping point; yet this has frequently been done.

Therefore, this ideal melting point figure is impossible of realization. We may as well face the fact that melting point or dropping point determinations are empirical things, correct only because they comply with an agreed definition, and that the method which is adopted by the largest number of the persons concerned automatically becomes the "best". Such a standard measure of the progressive softening which occurs when the temperature is raised gives valuable information as to the materials and workmanship used in making a grease, but this figure alone is not a measure of safe operating temperature.

Lubricating Ability

It has sometimes been stated that the thickening of oils with soap merely puts the oil into a form where it can be conveniently and economically applied as a lubricant. Arvesan[2] has shown that the viscosity of a grease at high rates of shear approaches that of the oil from which it was made. This turns out to be a remarkable advantage in favor of the use of grease in certain positions, releasing us from the fear of high internal losses due to a grease being too heavy for high speeds, but it has been interpreted by some as indicating that, after all, when we lubricate with grease, we only apply oil in a different form.

This is more or less true with regard to lubrication under perfect film conditions where a hydrodynamic pressure of lubricant can be built up by the fast rotating bearing, but it falls far short of stating the case in conditions where these requirements are not met.

We must go back to the fundamental distinction in lubrication theory between floating film conditions and broken film conditions, which cannot be emphasized too clearly. In the first case, the motion of the journal tends to draw in lubricant faster than it can squeeze out at the ends of the bearing, and the chemical nature or oiliness of the lubricant is not important. In the second case, where the speed is not high enough or steady enough, and in reciprocating parts or in misaligned bearings, such a cushion of lubricant cannot be depended upon, and metal-to-metal contact exists unless there is present a sufficient quantity of substances in the lubricant to form a protective film on the metal and resist being squeezed or scraped away. Small amounts of high molecular weight fats and fatty acids, also certain ketones, lactones and other polar compounds, have been found to produce the desired effect. Traces of soaps dissolved in oils, such as may occur in lubricating greases, also reduce the friction in this broken-film stage. We thus have two aids to better lubrication when using grease; the lubricant does not squeeze out so easily, thus insuring "floating" conditions a larger proportion of the time; and, when the ideal fluid film cannot be maintained, the oil-soap mixture has greater lubricating power.

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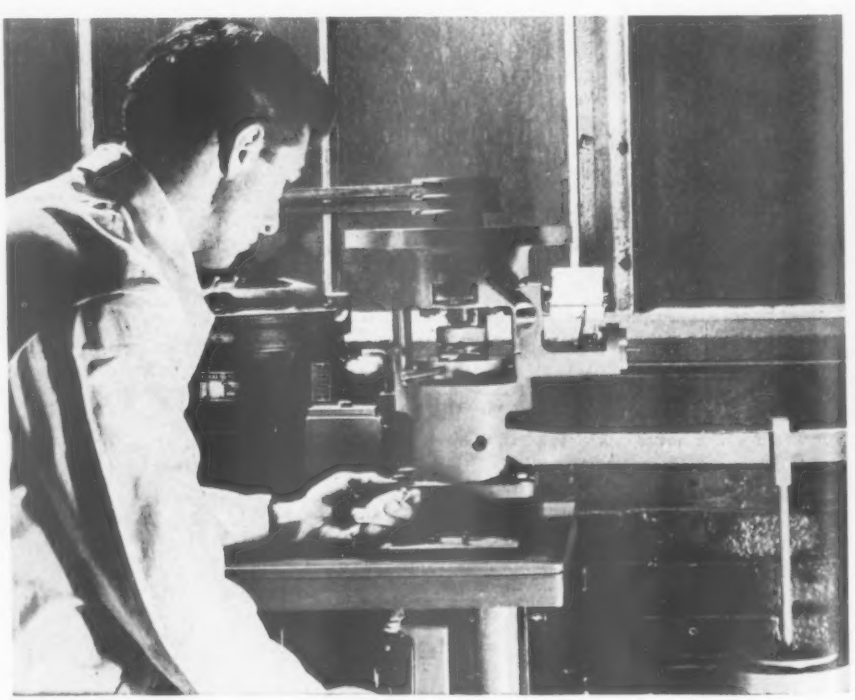

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Lubricating Grease Requirements For Modern Military Aircraft*

By E. R. Irwin** and Capt. S. C. Britton***

Aircraft requirements impose severe demands on lubricating grease. In addition to many varied mechanical requirements, temperatures vary sharply with altitude flown and transport planes may move from summer to winter ground conditions within a relatively short time. Further limitations in storage, handling and application are inherent in military service.

While satisfactory aeronautical greases are available, room for improvement exists and development of test methods more accurately predicting serviceability is important to assist in improving these lubricants.

1—Introduction

MODERN military aircraft depend on lubricants for proper functioning to perhaps a greater extent than any other piece of military or commercial equipment. Aircraft engines in themselves are very broad in their requirements, while other moving parts, particularly the control system, provide an entirely different set of conditions. A number of frictional surfaces are known which will operate satisfactorily without lubrication, but in most of these cases it is necessary to apply some sort of greasy material to prevent rusting, which would hinder or prevent operation. Relatively long periods of idleness during bad weather or repairs increases the need for rust preventive lubrication. Because of the difficulty of relubrication of many parts and to eliminate plumbing, greases are used to a great extent and, in order to satisfy the many requirements, several different types and grades are required.

The range and speed of present aircraft, which will probably be further extended, pose lubrication problems not encountered in other transportation. Not only does temperature vary sharply with altitude but a modern transport plane may move from summer to winter ground conditions in 24 to 48 hours elapsed time. Light weight equipment means more pay load, at least double the weight saved. In power producing mechanisms light weight means high speed and so the high speed electric motor becomes useful.

More items of lubricants increase the probability of mistakes, increase cost of operation and supply difficulties. The problem therefore becomes one of selecting the fewest possible number of greases to meet the necessary requirements of temperature range, speeds, loads, and nature of applications. Good stability, both chemically and physically, is required, and each grease should have as many desirable performance properties as possible in order to permit the minimum number of greases and lubrications.

This paper will attempt to inform the grease manufacturer who has not made a study of aircraft lubrication, concerning the grease requirements for military aircraft. It will explain why these requirements are thought to be justified. For those grease manufacturers who have been in close contact with aircraft manufacturers it may present a general picture, including some points not encountered by their own work. The paper will be general in nature but will try to give a sufficient number of specific examples to establish certain requirements. It will also discuss current methods used for the examination of lubricating greases and the author's views concerning the construction of specifications for aircraft greases.

2—General Requirements

In any discussion of lubrication requirements for military materiel, three essential considerations must always be borne in mind: First, the lubrication characteristics and demands of the part being lubricated; second, the availability of the lubricants required; third, the problems of supply in the field. From the standpoint of good logistics, it would be very desirable to be able to lubricate all parts with one grease in the field, or better yet, have all parts so designed and lubricated that no further servicing would be required after the airplane left the manufacturer's plant. The lubrication requirements of aircraft components are so exacting and so broad, that a single satisfactory grease could only be described in Hollywood's supercolossal adjectives. Since there is no such material at the present time, the problem becomes one of supplying the minimum number of greases obtainable in adequate quantities that will do a satisfactory job over the entire range of operating conditions. The field of grease research and development is wide open and we have "not yet begun to fight".

The range of temperatures over which aircraft greases are expected to give satisfactory performance is probably the most severe requirement to be met and is one of the important factors which set aircraft lubrication apart from lubrication of ground equipment. Aircraft and equipment must be kept to a minimum weight; this tends toward reduction of torque available for overcoming the frictional resistance of the grease and toward high temperature rises in some lubricated parts.

Temperatures Encountered

After careful study of available data, the range of ambient air temperatures at which satisfactory operation of all aircraft is expected is defined at the present time as −65° F to +160° F. Actually, the range of ambient temperatures may be somewhat broader. Data recently reported by Klein (1) indicates that temperatures as low as —120° F have been measured at 53,000 ft. It was further pointed out that temperatures at high altitudes are lower over the equator than at the poles. On the high end of the range, temperatures as high as 180° F have been measured in closed-in compartments of aircraft in the hot desert sun.

The actual operating temperature range is, of course, broader than that for ambient temperatures, due to temperature rises in the lubricated parts. Such temperature rises are most serious in the case of engine accessories, where the bearings receive heat from the engine as well as from sources normally causing a temperature rise. The normal operating temperature range to which grease may be subjected can be considered to be −65° F to +300° F, and with artificial heat being supplied at low ground temperatures, −20° F to +300° F.

Here again, we may occasionally expect temperatures beyond the range given. For example, a number of accessory manufacturers have stated that bearing temperatures as high as 350° F can be expected. It is realized that even the best lubricating oils begin to deteriorate rapidly at temperatures above 300° F and it is hoped that the high end of the temperature range can be kept within reason by improved design. A few examples of normal operating temperature ranges are given below:

Unit and Part	Low Temp. —Deg. Fahr.—	Normal Max. Oper. Temp.
Generator Bearings	—30	250
Starter Gears and Bearings	—30	200
Magneto Bearings and Gears	—30	260
Wheel Bearings	—65	300
Electric Propeller Motors	—65	175
Inverters and Amplidynes	—65	220
Control Pulley Bearings	—65	175
Retracting and Flap Motors	—65	200

A most essential prerequisite of any

*Presented before National Lubricating Grease Institute, Chicago, Nov. 1, 1943.

Note—This paper presents the views of the authors as of this date and does not necessarily constitute an official statement of the Materiel Command.

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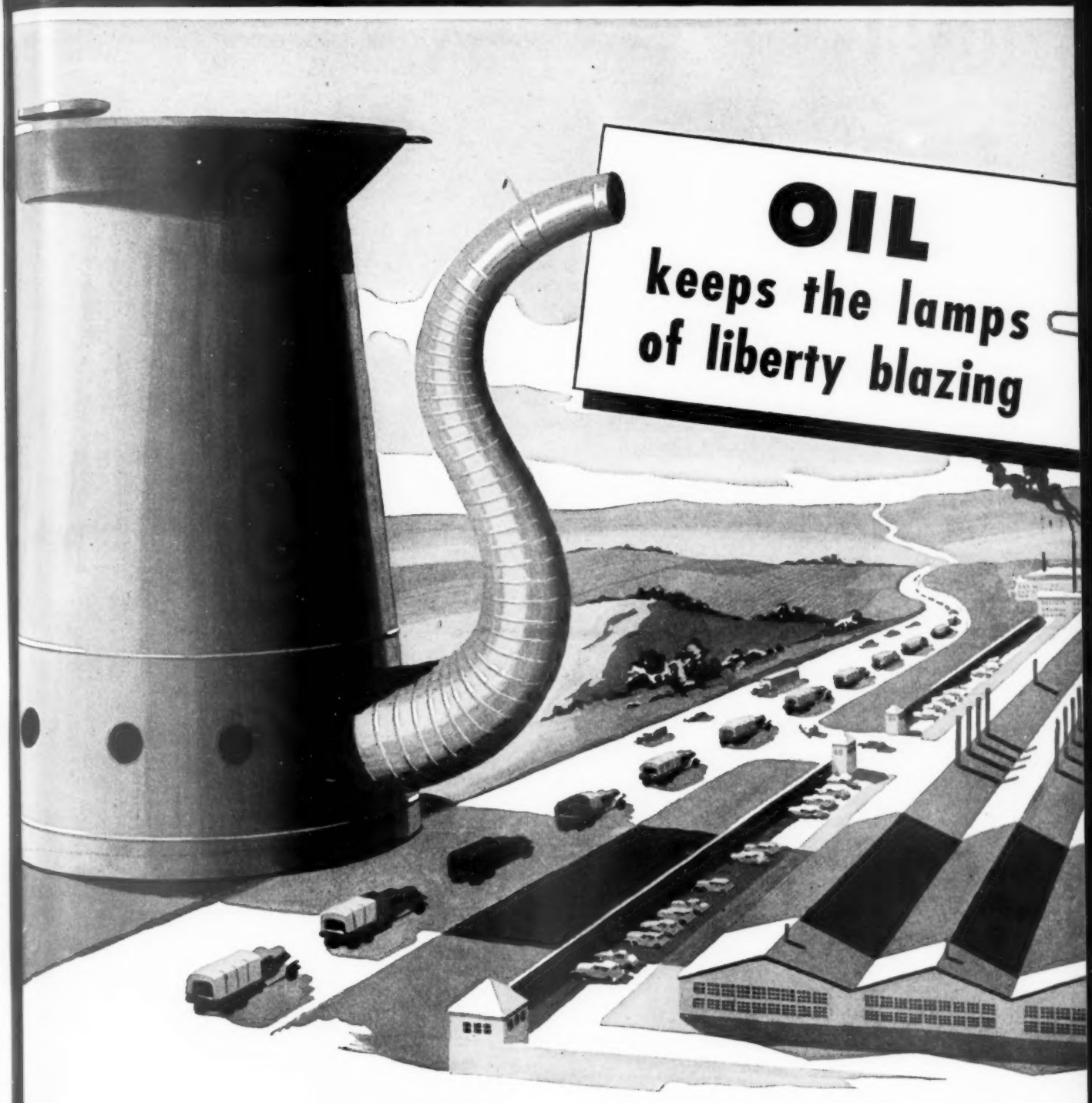

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aircraft component is absolute reliability. It is grim humor indeed to state that a defective airplane or component part will be cheerfully replaced if it fails to function in the air. Assuming that proper selection of grease is made initially, stability in storage and in service are the most important grease characteristics affecting reliable operation of lubricated parts.

Storage stability is essential in two ways. First, we must be reasonably certain that grease applied in the field is the same material which met our specifications at the grease factory and upon which our recommendations for application were based. Instructions to the field on how to mix separated oil back into a grease or on how to use a grease which has completely liquefied would not be appreciated even if it were feasible to publish such information.

Second, grease applied to sealed and prelubricated anti-friction bearings used as spare part stock must be sufficiently stable to insure satisfactory operation of the bearing when it is used for repair of an essential component. Sealed bearings are not easy to relubricate in the field. While it is true that demand for supplies and spares is now such that ordinarily shelf life is unimportant, it is possible that grease may be stored at high temperatures or under other adverse conditions for a year or more. The requirement of service stability is that the grease not change in structure or composition for the overhaul life of the part lubricated. This can be considered of the order of 500 flying hours, more or less intermittently. Of course many of our aircraft may not be in the air that long but many may be serviceable for much longer time.

Two requirements for aircraft lubricating greases over which some difference in opinion exists at the present are water resistance and corrosion prevention. The presence of water to a greater or lesser degree may always be expected depending upon the design of the part and conditions of operation. Sealed bearings in starters and generators may be thought to present no water and corrosion resistance problem, yet due to "breathing" of warm moist air and subsequent chilling appreciable moisture may condense in such locations. Wheel bearings, landing gear linkage, and retracting screws on the other hand may be subjected to a water spray of considerable force on landing in wet locations or on shipboard. For such locations it might be expected that a completely water repellent grease would be most desirable. However, it is known that such parts lubricated with a water repellent grease have badly corroded, while soda soap greases have been used for aircraft wheel bearings for some time with little difficulty being reported. It appears that an ideal grease should:

(a) Resist washing action of water and be adherent to the surfaces lubricated.

(b) Absorb water to a limited extent without appreciable change in physical properties.

(c) Inhibit corrosion.

Knowledge of the actual requirements for extreme pressure properties for aircraft greases is limited. As might be expected, application of E.P. greases is generally required by highly loaded gears, screws, and chains, although some applications have been found to heavily loaded needle bearings and E.P. greases are often used for plug valve lubrication. The need for E.P. grease is generally found by a process of trial and error. However, the uses of E.P. greases are not extensive in aircraft, as not all gears, screws, etc. require such products, although the trend toward using lighter oils in greases to obtain satisfactory low temperature operation will probably enlarge the extent to which such greases are applied. In this respect only the constant striving against weight probably aids the performance of the lubricants and has made the grease manufacturer's problems less difficult. To date, mild E.P. additives have been adequate for all applications requiring such properties. The most extensive application has been to retracting gears and screws.

A grease may answer all other problems to the nth degree, but if the grease is not clean, it no longer is a lubricant. Cleanliness is particularly important in the case of antifriction bearings. Generally, little trouble is experienced at the source of the grease, and the problem of keeping a grease clean resolves to one of obtaining proper handling of lubrication in the field. The field problem is a difficult one at best and probably the surest solution would be to package all grease in tubes.

3—Application of Grease to Aircraft

We will attempt to describe the grease requirements of the various types of aircraft components.

Lubrication of antifriction bearings probably represents the most important and at the same time, the most difficult grease problem on the airplane. It is in such applications that the greatest extremes in temperature of operation are encountered and the fact that such bearings are used indicates that a high degree of performance is desired. However, the development of shielded bearings fortunately has made the problem easier from the standpoint of the grease manufacturer. This is particularly true of control pulley bearings where it is difficult to believe that aircraft were ever flown without such bearings.

The light weight, high speed, and high output of aircraft electrical equipment, such as generators, retracting motors, and starters, have made the use of antifriction bearings almost a "must" requirement. Nearly every type of antifriction bearing will be found in such equipment and the service will vary from light intermittent duty servo motors to high output, hot running generators. Approximately 70 to 80% of the bearings will be single row, either single or double shielded. Bearing speeds will run from 2500 rpm for aircraft generators, to 8000 rpm for continuous duty motors, 12,000 rpm for intermittent duty motors, and as high as 20,000 rpm for starters. An excellent discussion of various characteristics and design trends of aircraft electrical equipment has been given recently by Holliday (2).

Variation in temperature rise and torque available tend to make the selection of the lubricant even more difficult. Generally speaking, for equipment running at low temperatures, or intermittently, and where low torque is available at low temperatures, AN-G-3a type of grease is usually specified. For equipment such as dynamotors, where extra torque is available at low temperatures and where continuous running will cause a moderately high temperature rise, a medium grade soda soap grease is applied. For very hot running equipment, such as engine accessories, a very stable, high melting point grease is required. In such cases heat applied to the engine previous to start-up aids in solving the low temperature problem.

Wheel and Pulley Bearings

Wheel bearing lubrication represents a severe service somewhat different than in the case of electrical equipment. The service is quite intermittent, and since a great deal of heat is generated by the brakes in stopping heavy bombardment aircraft, the temperature rise may be high and may be rapid. A certain amount of water resistance and corrosion resistance is, of course, required in this application, and for this reason aluminum soap greases were used for some time. However, such greases will not stand the thermal shocks given in heavy power braked wheel bearing service, and considerable trouble has been noted in the grease running out over the brake surfaces. Use of sealed bearings is not practicable. Torque at low temperatures does not appear to be an important consideration in wheel bearing lubrication. Medium grade soda soap greases now appear to give best all-round service in wheel bearings with a somewhat heavier grade necessary when ground temperatures are high and operation is particularly severe.

On the other hand, temperature rise in operation does not apply in the case of control pulley bearings, but the lowest possible torque must be obtained at low temperatures in order to maintain maneuverability and to assure satisfactory operation of automatic flight control equipment. Shielded bearings help in this case, although satisfactory grease stability must be maintained as high as 180° F. Greases of the AN-G-3 types are applicable here, although it appears that better low temperature character-

istics must be obtained to assure continued satisfactory operation at the increasingly higher altitudes being used by both military and commercial aircraft.

Propeller hub lubrication is not particularly difficult as regards high temperature problems. However, since the rate of pitch change should be kept as nearly constant as possible, adequate low temperature greases are demanded. In this application specification AN-G-3 grease appears to be most applicable.

Other Applications

Other applications of antifriction bearings include aircraft camera and radio equipment. In most of such applications high temperature stability is not too important, but with the "fly-power" motors used the best in low temperature grease characteristics are demanded. It is now indicated that greases similar to AN-G-3a, but with smaller low temperature torque are the answer to our problems in such cases. Several such greases are now available.

Lubrication of gears, screws, chains and threads, of course, is somewhat different from lubrication of antifriction bearings. The low temperature problem is still paramount, but the temperature range required is not so broad. On the other hand, better load-carrying capacity, flowability, adherence, and corrosion resistance are required. In the case of starter gears, graphite grease made from a low viscosity mineral oil has been the rule. The reasoning behind this selection appears to be based partly upon the assumption that while the starter will not be relubricated in service, some graphite will remain to lubricate the gear surfaces in the event that the main body of the grease is centrifuged off the gears. However, no data have been shown to indicate that a mild E.P. grease with good low temperature characteristics would not do a better job and such grease is now being tested by the Materiel Command for the purpose.

High on the list of applications for gear lubricants are the various retracting gears and screws. In most of such applications a mild E.P. lubricant is required. Generally a light gear oil would be desirable, but design considerations are often such that a satisfactorily tight gear housing cannot be obtained. Here a light E.P. grease is applicable, and normally AN-G-10 grease is recommended for the purpose.

Various schools of thought exist on the topic of thread lubricants, and for this reason a wide range of products will be found available commercially. A perfectly machined thread should require no lubrication at all, but usually some lubricant must be applied in order to insure maximum linear engagement of the threads for best holding and sealing properties without galling or seizing of the threads. The problem then becomes one for an E.P. type material, such as Specification 3571 lead soap grease.

Other applications of grease to aircraft components include packing grease for coolant pumps. This application is similar in many respects to automotive water pump lubrication, except that considerably higher temperatures are involved (of the order of 350° F) and better packing and lubricating properties are expected. No completely satisfactory grease has been found for this job, although a hard grade of graphite grease will perform fairly well.

The "chassis" lubrication of an airplane consists of lubricating the pivot points on the various landing gear linkages. About 75% of these are plain bushings, the remainder needle bearings. All are lubricated through conventional pressure gun fittings. Here water and corrosion resistance are the grease properties to consider, as well as adherence. Flowability at low temperatures, while not as important as in other applications, must also be considered. A heavy aluminum soap grease is applicable in the summer, while AN-G-3a is required in the winter. It is suggested that the intermediate type grease mentioned below should be adequate for year-round use.

Lubrication of plug valves has also received some attention. Here, the grease must act as an antiseize as well as a sealing compound. Gasoline insoluble greases, generally castor oil base materials, are often used for plug valve lubrication, and although such greases are not entirely satisfactory at low temperatures, they must be used on fuel line valves. On plug valves for other lines (except oxygen) AN-G-3a grease or its E.P. variation, AN-G-10, have been specified.

Finally, we come to enclosed universals, flexible shafts and flexible drive cables. Requirements here are for satisfactory low temperature torque and for the grease to satisfactorily fill the housing to prevent accumulation and freezing of water.

4—Methods of Test and Specifications

A specification should do two things. It should tell the manufacturer what the customer wants and it should tell the inspector how to determine whether or not the submitted grease is satisfactory. The two are not necessarily synonymous. Properties which are commonly used by the manufacturer to identify and control a product are not necessarily related to performance but it is believed that such properties may reasonably be included in the requirements of a specification. Likewise it is sometimes found that simply determined effects have or seem to have some association with phases of performance apparently not logically related. It is also noted that to prove that a certain property is not related to performance does not prove that it is not valuable for specification control. Carried to an absurdity this might be expressed as follows: No part of a ball cut into pieces will roll, and therefore a ball will not roll. Specifically we may say that to prove that melting point, evaporation, and bleeding of a grease separately considered do not indicate its high temperature physical stability, does not at all prove that the proper correlation and consideration of the three properties would be equally inadequate.

Another feature of specifications which will probably result in controversy in any large group is the extent to which the purchaser is reasonably justified in requiring uniformity in products purchased. In the case of lubricating oils and liquid fuels this is not a troublesome factor since such products which are suitable for a certain use are always similar in physical properties and appearance if not in composition. In the case of lubricating greases products of quite different feel and appearance may actually be suitable for the same applications. However, if purchases are made of such apparently entirely different products it results in uncertainty and bad psychological reaction on the part of the operators using them. It is noted that the German aircraft greases are artificially colored, probably as a means of ready identification, but possibly also to provide more uniform appearance for different examples of the same material.

Army-Navy aeronautical (ANA) specifications for greases usually provide for purchase of the grease only from approved sources and therefore require that manufacturers submit samples for qualification prior to acceptance of material on contract. This practice leads to the distinction between qualification tests and inspection tests. The qualification tests usually include one or more actual service tests in a representative piece of equipment. Inspection tests are limited to those tests which can be made in a reasonably short time, preferably not more than one day, and which serve to identify the product as equal to or similar to the sample originally submitted to qualification test and approved.

For the purposes of this paper the authors have divided tests of greases into four main classes as follows:

(a) Elimination of undesirable ingredients
(b) Flow—pressure properties
(c) Stability
(d) Others

Tests to eliminate undesirable and contaminating ingredients include examination for odor and appearance, corrosion, and solid impurities. A careful examination for homogeneity is believed to be an important item, and by this is not only meant recording of oil separation but also of any tendency to surface oxidation, undispersed soap particles, and irregular structure. This is an example of the illogical control tests mentioned above. It is believed by the authors and agreed to by at least some producer technologists that the fiber type of soda base grease is

generally inferior to the smooth type, at least for antifriction bearings.

AAF specifications (3) have therefore required the smooth, non-fibrous or short fiber type, a point difficult to justify except by mutual agreement of producer and consumer. A corrosion test with copper (by the usual ASTM method) is considered justifiable for the information of the manufacturer. Solid impurities may be controlled by the ASTM test for insoluble matter, preferably followed by further examinations as to the nature of any insoluble material found, or by low power microscopic examination of the grease itself.

Tests of Flow Properties

The flow properties of greases are important in controlling loss of grease from housings, power requirements at low temperatures and lubrication effectiveness (4). ANA specifications at present measure torque at low temperature in a Conrad, No. 204, 8-ball bearing. This is not considered the final and most desirable method. It was adopted because low torque of ball bearings at low temperatures is a most essential feature of aircraft operation. The original concept of this test, determination of shear at one torque and one temperature has been amplified by various operators to include the "Plasticity Number," which equals torque times seconds for one revolution, at various torques and temperatures. The original method, still ANA specified, is a useful "go" or "no go" test. The plasticity number provides a better comparison of two or more greases.

The Army Air Force and Bureau of Aeronautics of the Navy Dept. are cooperating with the Coordinating Lubricants Research (CLR) Committee's advisory group on greases in the evaluation of the Standard Oil Development (SOD) viscometer. This is a pressure orifice type instrument arranged for use over a wide range of high and low temperatures. The AAF is also constructing a concentric cylinder viscometer. It is evident that considerable study and test work is required before this important property of greases can be considered satisfactorily evaluated.

Allied to, but by no means directly related to, the shear or flow properties of greases is the ASTM penetration test for consistency. First editions of ANA grease specifications did not include this test but it is now being added to all specifications following discussion with the CLR advisory group. This is another and excellent example of a test which is slightly if at all related to performance values but is considered valuable for the fol'owing reasons:

(1) To inform the grease manufacturer concerning the general character desired.

(2) To control application properties, particularly of greases furnished in collapsible tubes.

(3) To aid the inspector in identifying the qualified product.

(4) To improve confidence of the service personnel concerning uniformity and suitability.

Two Stability Factors

Stability of greases is usually divided into two considerations, storage and service. For much aircraft use they are probably synonymous because of the small percentage of operating time in elapsed time. However, they will be considered separately. Storage stability is usually determined by actual storage by the manufacturer and by bomb oxidation by the purchaser. It is easy to criticize the former for lack of imagination and industry to produce a more rapid evaluation and it is equally easy to criticize the latter for lack of correlation and probable inaccuracy. It is difficult to suggest anything better. Bleeding and evaporation tests would appear to apply to both storage and service stability. No direct correlation has been made by Materiel Command laboratories or, as far as is known, by other laboratories. The methods and values specified in ANA specifications are descriptive of a few greases known to be generally satisfactory and superior to the older conventional commercial types.

Mechanical tests for operating stability will be included in two ANA specifications, one now in preparation and one undergoing repairs, for high-temperature, high-speed greases. These will consist of various runs in carefully standardized ball bearings. It is to be noted that only individually checked bearings may be used for such work since the condition of the bearing is important in obtaining reproducible results. Test data in motors at 22,000 rpm previously obtained by the AAF and at 10,000 rpm to be obtained will be furnished to the Naval Engineering Experiment Station to aid in establishing specification limits on the Navy grease testing equipment. Some persons of considerable experience have advised the authors that penetration, melting point and bleeding after long working in the ASTM worker demonstrates service stability. It is certainly worthy of hope that the cooperating laboratories in the present CLR program will be able to evaluate a number of such procedures and that simple, easily standardized equipment will be proved adequate.

Miscellaneous Tests

Miscellaneous tests of interest to the writer of specifications and the producer alike include melting point, water resistance, corrosion prevention and film strength. It is concluded that melting point is a justifiable specification requirement on much the same grounds as the penetration. Water resistance is the subject of a great deal of discussion whenever ANA specifications are being considered. It is hoped that the CLR advisory group will have something definite to recommend in the near future. In the meantime the present Navy test will be continued. It is considered adequate, perhaps more restrictive than necessary. Corrosion preventive properties of greases should be studied. Some large consumers (5) have made considerable studies but data have not been collected and analyzed by any known authoritative cooperative group.

The primary function of a lubricant, that is its inherent tendency to reduce wear and friction of moving surfaces, is one of the most difficultly evaluated properties. The authors concur in the selection of the Four-Ball tester for the purpose. The calculation of pressure-wear index (PWI) (6) may appear needlessly and unjustifiably complicated to some, but it is believed that analysis of the lubricating function will establish the desirability of the method. The extension of the range of boundary lubrication is an important factor in preventing the occurrence of welding and consequent destruction of the frictional surfaces under conditions of incipient welding. A higher value for the PWI indicates a greater extension of boundary lubrication, that is, the range of incipient seizure without destructive welding. It is concluded from available data that a PWI of 15 provides adequate protection for all known aircraft gear installations with considerable margin of safety in most applications.

It is suggested that a minimum value for the initial delayed seizure load should also be included in the Four-Ball evaluation in order to define properly the minimum wear capacity of the lubricant. Data available are insufficient to establish the desired value at this time. Due to the highly controversial situation of wear testing no comparative discussion of the various machines in use will be attempted. It is believed, however, that expecting any one test machine to accurately rate all lubricants for all applications is a good deal like expecting one knock test engine to accurately rate all gasoline for all engines, a condition never indicated to the cautious and given up long ago by the more optimistic. The reasonable goal is a test which, by allowing a considerable margin of estimated surplus capacity, will insure satisfactory performance in the great majority of applications.

5—Summary of Aeronautical Grease Specifications

A condensed summary of current specifications covering greases for military aircraft is given in Table 1. The trend to be noted here is toward performance type tests rather than the older material requirements. The various applications of these greases are summarized in Table 2.

While considerable progress has been made in the direction of simplification of grease specifications, examination of the above tables will indicate further improvement is necessary. The ideal would be one grease for all applications. At the present state of development of aircraft and the art of grease making, it appears

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Table 1—Condensed Summary of Aeronautical Grease Specifications

Grease	High Melting Point	Lead Soap Base	Low Temperature	Aluminum Soap Grade AA	Aluminum Soap Grade B	High Temperature Water Resistant	Graphite	Low Temperature E P	Gasoline Resistant
Specification No.	AAF 3560E Medium	AAF 3571B	AN-G-3a	AN-G-4	AN-G-4	AN-G-5	AN-G-6	AN-G-10	AN-G-14
Are Qualification Tests Required	No	No	Yes	No	No	Yes	No	Yes	No
General and Physical Requirements									
Color		Optional							Lt. Yellow to Brown
Odor		No perfume	No perfume, nor rancidity	No perfume	No perfume	No perfume nor rancidity	No perfume nor rancidity	No perfume nor rancidity	
Homogeneity	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Penetration (worked, 77°F.)	240-290	240-300	265-340 (d) & (m)	310-340	355-385	(d)	320-380	310-385 (d) & (m)	180-260
Melting (Dropping) Point Min, °F.	275°F.		300°F. (e)	190	250	375, (e)		300, (e)	260
Chemical Requirements									
Soap	70% Na + K, 10% Al	(b)	Lithium	Aluminum	Aluminum	Sodium	Usually Calcium	Lithium	Sodium and/or potassium
Ash, As soap base, Max, %				1.5	2.0				2-4
Oil Content, Min, %	83	75		87	86		80		75-87
Properties of Oil									
Color, ASTM, Max	7			8	8				(g)
Viscosity at 210°F, SSU		140-220			178-218				
Viscosity at 100°F, SSU	200 Min			232-312			190-325 (m)		5,100-7,900
Viscosity at 0°F, SSU	50,000 Max								
Viscosity Index					80				
Flash point, Min, °F.				290	500		300		420
Pour point, Max, °F.	0			—25	+30		—25		
Insoluble Matter, Max, %	0.2	3.0 (Tar)		0.2	0.2				(i)
Water, Max, %	0.5	1.0		0.5	0.3		1.5		2.0
Neutralization No									10
Free Alkalies (as NaOH) Max, %	0.1	0.2					0.10 (CaOH)		
Free Fatty Acid (as Oleic) Max, %	0.2	0.5					0.2		
Dirt Count									
Over 0.001 in dia, per cc			7,500					7,500	
Over 0.003 in dia, per cc			1,600					1,600	
Over 0.005 in dia, per cc			None					None	
Corrosion and Stability	Negative No Separation	Negative	Negative No Separation	Negative Homogeneous	Negative Homogeneous		Negative No separation	Negative No separation	(h)
Additives and Fillers	None	(c)	None	No fillers		No fillers	(f)	No fillers, EP Additive	No fillers nor rosin
Performance Test Requirements									
Low Temperature Torque									
Temperature, °F.			—67					—67	
Torque, gm-cm			2.000					2 000	
Sec. for 1 rev, max, Orig			15					30	
Sec. for 1 rev, max, after bleeding and evaporation			50% inc. max.					Max 30% inc.	
Sec. for 1 rev, max, after 3 mos. storage			50% inc. max.					30 sec.	
Bleeding, max, %			5	16	5			5	
Evaporation, max, %			10					15	
Grease Loss, max, %			10					10	
Pressure-Wear Index								15	
Water Absorption(max, %			100			100		100	
Navy Grease Machine						Required, (k)			
Navy Beater Test						Required, (l)			
Oxidation, lbs drop in 100 hrs.			5					5	

that a goal of 4 greases is desirable and attainable, as follows:

(1) A low temperature grease. Such a grease should have satisfactory water resisting qualities and a range of satisfactory operation as nearly as possible to —90°F. to +180°F.

(2) An intermediate, general purpose grease. Such a material could have a temperature range of —30°F. to +250°F.

(3) A high temperature, heavy duty grease with desired low temperature limit of 0°F. and a requirement for satisfactory life and operation up to 325°F.

(4) An E. P. variation of either 1, or 2, above.

6—Summary

To summarize the points brought out in this paper:

(1) Aircraft requirements impose severe limitations on all lubricants, particularly greases.

(2) Military requirements impose further limitations.

(3) Although satisfactory greases are becoming available, considerable room for improvement exists.

(4) Development of test methods more accurately predicting serviceability should be continued in order to assist in the development of improved greases.

NLGI

REFERENCES

(1) Frank D. Klein, Use of Petroleum Products in Aircraft, SAE Jo., 51, 305 (1943).
(2) Lt. Col. T. B. Holliday, SAE Jo., 51, 234 (1943).
(3) AAF Specification 3560.
(4) J. O. Almen, Mech. Eng., 415 (June 1937).
(5) Private communications with motor manufacturers and other users.
(6) Specification AN-G-10.

Table 2—Condensed Summary of Application of Specification Greases to Military Aircraft

GREASE	SPEC.	GRADE	INTENDED APPLICATION
High Melting Point	3560-E	Med.	Ball and roller bearings where low temperature torque is not essential; e. g.; landing wheel bearings, dynamotor bearings.
Lead Soap Base	3571-B	....	Thread lubricant. Also may be specified for summer lubrication of heavily loaded gears where gear oils cannot be retained in housing.
Low Temperature	AN-G-3a	....	Ball and roller bearings, enclosed universals, tachometer shafts, slides and rollers where low torque at low temperatures is prime requirement. Examples; Control pulley bearings, retracting and flap motor bearings, flap guides and rollers, propeller hubs.
Aluminum Soap	AN-G-4	AA & B	Aluminum soap greases are used where water resistance, long retention, and corrosion resistance are more important than a wide temperature range of applicability. Not recommended for parts operating over 160°F. Grade AA for low temperatures, grade B for moderate summer temperatures. Grade B used for summer lubrication of landing gear linkage.
High Temperature, Water Resistant	AN-G-5	....	Ball and roller bearings and related applications for extreme high temperature operation and where water resistance is a factor. Examples; Landing wheel bearings (summer, severe service) magneto and generator bearings. Not suitable where low temperature torque is critical.
Graphite	AN-G-6	....	Gears, bearings and chains where very infrequent lubrication is possible and where heavy sliding or shock loads are a factor. Not generally suitable for anti-friction bearings, electrical equipment or extreme high or low temperatures.
Low Temperature, E. P.	AN-G-10	....	Gears, screws, worms, chains, and plug valves where low temperature torque is essential and where better load carrying capacity than AN-G-3a is required.
Gasoline Resistant	AN-G-14	....	Lubrication of fuel pump bearings, plug valves for fuel lines, anti-seize compound, and as a gasket sealing compound.

Notes to Table 1

(a) Smooth, Homogeneous, free from crusts, lumps, etc.

(b) Total soap 20% max, Pb soap 10% min.

(c) Fillers, none; sulfurized and chlorinated oils may be present.

(d) Normal range given; specification requires deviation from qualification sample ±10%, max.

(e) Melting point shall not differ from qualification sample by more than ±12.6°F.

(f) No fillers or rosin oils. 4 to 5% graphite (99%, min, graphitic carbon, 98%, min 200 mesh, non-scratching).

(g) Vegetable (usually castor) oil used; Iodine No. (Wijs) max, 110; Neutralization No., max, 20.

(h) Grease shall not corrode copper at room temperature, 3 hrs.

(i) Grease shall be not more than 10% soluble in 40% aromatic gasoline.

Requirement may have to be revised, difficult to get greases which meet requirement.

(j) Layer grease, ⅛ in. on steel plate, 7 days at 212°F, shall not harden, separate, net change.

(k) Navy Grease Machine.

Run I, 600 RPM at 100°F.
(1) Torque at 15 sec, gm-cm, max, 200% (2).
(2) Torque at 5 min, gm-cm, 300-500.
(3) Torque at 60 min, gm-cm, min 75% (2).
(4) Leakage, %, max, 70.

Run Ia, as above after 1 hr at 2500 CM and 250°F.
(1) Torque at 15 sec, gm-cm, 50-150% of I (1).
(2) Torque at 5 min, gm-cm, 50-150% of I (2).
(3) Torque at 60 min, gm-cm, 50-150% of I (3).
(4) Total Leakage, %, max, 85.

Run II, on Beater Residue, 600 RPM at 100°F.
(1) Torque at 15 sec, gm-cm, 70-200% of I (1).
(2) Torque at 5 min, gm-cm, 70-200% of I (2).
(3) Torque at 60 min, gm-cm, 50-140% of I (3).
(4) Leakage, %, max, 60.

Run IIa, as for II after 1 hr at 2500 RPM and 350°F.
(1) Torque at 15 sec, gm-cm, 50-140% of I (1).
(2) Torque at 5 min, gm-cm, 50-140% of I (2).
(3) Torque at 60 min, gm-cm, 50-140% of I (3).
(4) Total Leakage, %, max, 75.

(l) Beater Test—After beater test grease shall be typical consistency, not granulated nor separated.

(m) Recommended values for changes now in process.

Research on New Processes and Equipment Reported to Chemical Engineers

By Robert R. White* and J. Louis York**

THE American Institute of Chemical Engineers held its 36th annual convention in Pittsburgh Nov. 14-16. More than 680 registrants met to make this the second largest meeting in the history of the institute and, because of the present emergency, one of the most important.

Professor George Granger Brown, chairman of the Department of Chemical and Metallurgical Engineering of the University of Michigan, was elected President of the Institute, succeeding J. L. Bennett, manager of chemical operations in the explosives division of the Hercules Powder Co.

Professor Brown, a consultant and author in the petroleum field, won the Institute's Walker medal in 1939 and the Hanlon Award of the Natural Gasoline Association in 1940.

Dr. L. W. Bass, director of the New England Industrial Research Foundation, Boston, was elected Vice-President. Stephen L. Tyler was reelected Secretary and Executive Secretary.

The paper, "Chemical Engineering Applications For Plastics," by T. S. Corswell and R. U. Haslanger, originated in the Plastics Division of the Monsanto Chemical Co. and was presented by Mr. Haslanger. The paper reviewed the increasing uses of plastics materials in industry and classified the various plastic materials into two broad fields—thermosetting and thermoplastic resins. The effect of exposure to chemical reagents, temperature, and other services showed that in many cases plastic materials are outperforming many of the structural and semi-structural materials. Of particular interest to refinery engineers and operators was the application of phenolic laminates as bearing material in pumps handling light hydrocarbons such as propane and butane.

One of the most interesting papers, "The Development of the Hydrogen Fluoride Alkylation Process" by C. G. Gerhold, J. O. Iverson, H. J. Nebeck and R. J. Newman of the Universal Oil Products Co. was presented by Mr. Nebeck. Excerpts from this paper are given in the following paragraphs:

"The hydrogen fluoride alkylation process is now playing an important role in the program to secure the maximum production of aviation gasoline for the fighting forces. The two major advantages of HF alkylation over the older sulfuric acid process are the higher process temperature and the ease of catalyst regeneration. The higher temperature permits the use of cooling water to remove the heat of reaction and thus eliminates critical refrigerating equipment.

Catalyst Regeneration

"Catalyst regeneration is an inherent feature of the process and catalyst consumption is so low that the raw material and plant requirements for catalyst manufacture are considerably smaller than those for a sulfuric acid alkylation unit on the basis of equal alkylate production. Elimination of spent catalyst disposal, which is a serious problem in many refineries using sulfuric acid alkylation, is a further advantage gained by catalyst regeneration.

"Charging stock to the plant passes through charge pretreaters which remove organic impurities and water that would otherwise contaminate the products or catalyst. After pretreatment the charge is combined with recycle isobutane and fed to the reaction system. The reaction is carried out in contactors equipped with efficient mixing devices, which maintain contact between the hydrocarbon and catalyst phases and with cooling coils which remove the heat of reaction. The effluent from the contactors passes to a settler in which aeration of the catalyst from hydrocarbon is made, the catalyst being returned to the reaction vessel and the hydrocarbon being fed to the fractionation system.

"The hydrocarbon stream leaving the settler contains a small amount of dissolved hydrogen fluoride and some organic fluorides. The first fractionation column strips the hydrocarbons of hydrogen fluoride, which is returned to the reaction zone.

Isobutane Recycled

"The bottoms from the stripper are fed to a treating section, in which fluorides are broken down and the liberated HF removed. The effluent from this heater is fed to a deisobutanizer, in which the isobutane is separated from the other hydrocarbons. This separation is necessary because a satisfactory alkylation operation requires high isobutane concentration in the contactor. This high concentration is obtained by recycling isobutane.

"Bottoms from the deisobutanizer are charged to a debutanizer, where normal butane is removed as overhead. The aviation alkylate is distilled from the debutanized total alkylate in the final fractionation step.

"Some propane is always present in the charge to an alkylation plant, and it must be removed from the system. In the case of alkylation operations in which the amount of propane is small, it is removed by depropanizing a portion of the recycle isobutane. When propane makes up a substantial portion of the feed, combined depropanizing and HF stripping of the reactor effluent are carried out in a stripper of modified design.

"Units for alkylating with amylenes have, in addition to the equipment shown, two fractionation columns for the recovery of high octane number isopentane and the elimination of low octane number normal pentane.

Regenerating Distillation Step

"As a result of side reactions, hydrocarbons of high molecular weight and low hydrogen content accumulate in the catalyst phase. In order that the activity may be kept at the desired level, these hydrocarbons are removed in a regenerating distillation step, in which the tars are taken out as bottoms and purified HF is removed as overhead. Accumulation of water in the catalyst phase is prevented by a second regeneration step, in which a part of the overhead from the first step is redistilled to remove water in the form of a constant boiling mixture containing about 37% HF. Regenerated catalyst is returned to the reaction zone."

Separation of Aromatics

The paper entitled "Extraction of Aromatics From Gasoline," by Allen S. Smith and J. E. Funk of the Blaw-Knox Co. was withdrawn from the program, to the disappointment of many of the members interested in this field. The program abstract of the article stated:

"The separation of aromatics from non-aromatics in a hydrocarbon mixture is possible by the use of two miscible solvents. The principle involved in selecting the ratio of the solvents is discussed. Equilibrium or solvent/feed ratio is not fixed by the operating temperature, as with single solvents, since the ratio of the solvents can be varied within limits to suit required conditions. Thus, a wide choice of solvents is available for a mixture of components of similar properties. The use of rectangular coordinates is shown to represent a hydrocarbon system with methanol or dipropylene glycol and ethylene glycol as the mixed solvents by experimental and pilot plant work with paraffin-naphthene-aromatic mixtures. The equilibrium and solubility diagrams should be determined for the aromatic and the most soluble non-

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**Instructor, Department of Chemical Engineering, University of Michigan.

aromatic component of lowest molecular weight to be encountered in gasoline extraction.

"Results are given for the operation of a 42-ft. packed column in continuous extraction of several cracked gasolines with extract reflux. The data show that all aromatics are readily separated from paraffins. Olefins and naphthenes are distributed between extract and raffinate in proportion to their initial ratio with the aromatics. The efficiency of the column used was inadequate to eliminate more than 93% of the paraffins and naphthenes present in the feed. The recovery of aromatics was 90-100% when operating for maximum aromatic concentration in the extract. By distillation and chemical treating of the extract from a whole gasoline, commercially pure aromatics are ultimately obtainable."

Nitration of Toluene

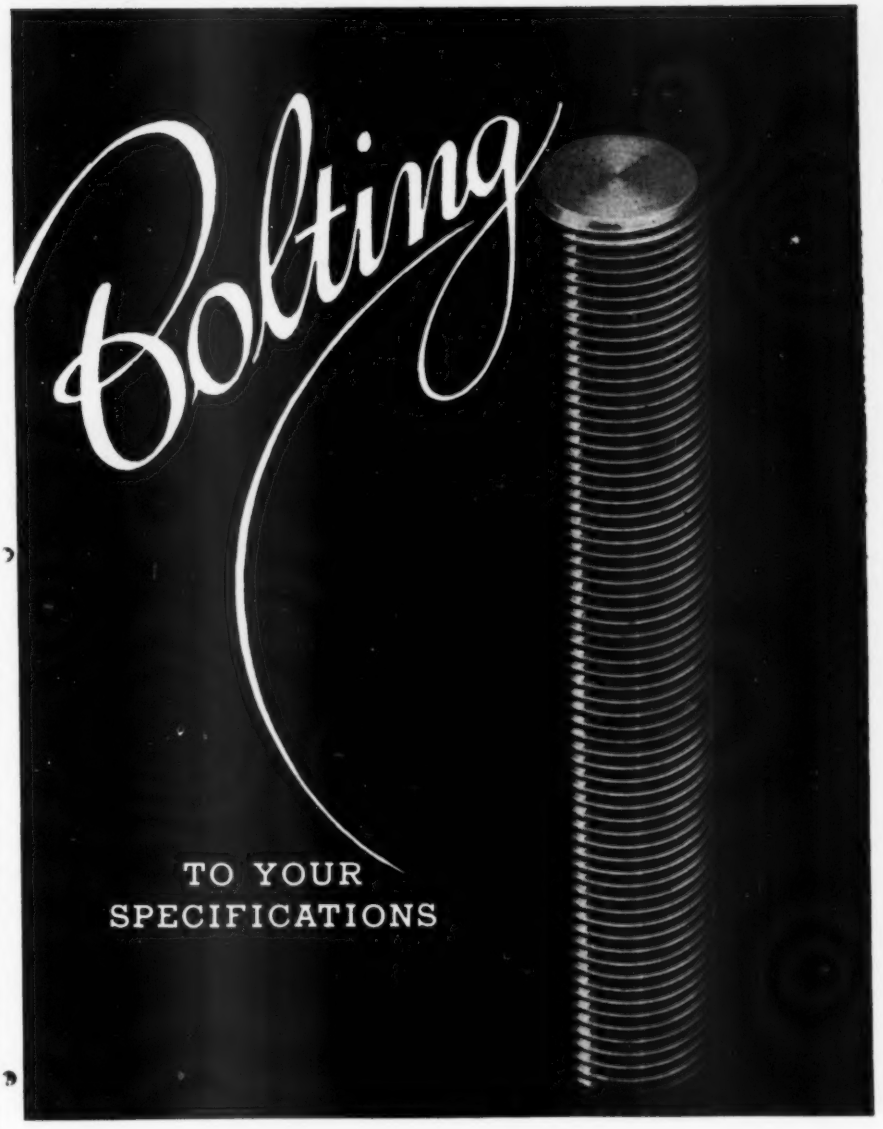
"The Rate of Nitration of Toluene With Mixed Acid," by Clyde McKinley and Robert R. White of the University of Michigan, dealt with the production of mononitrotoluene from emulsions containing toluene and mixed acids. While the subject dealt with a field ordinarily associated with the manufacture of explosives, the experimental results showing the effect of agitation on the rate of reaction are related to the rate of reaction obtained in the various alkylation processes where alkylate is produced from an emulsion of acid catalyst and hydrocarbon phase containing the isoparaffin and olefin. These data showed that above a critical amount of agitation, increased agitation had little effect upon the rate of production of mononitrotoluene since the rate of chemical reaction becomes controlling.

In "Closures For High Pressure Vessels," Douglas Meigs of the American Instrument Co. reviewed some of the problems encountered in the design of closures for high pressure vessels. He showed that while many types of construction have been devised and published for high pressure vessels, in general each closure is useful for a given class of service and is most applicable to a certain pressure range and a certain range of sizes, beyond which another design would be preferable. The most important factors to be considered by the designer are the pressure, frequency of opening, diameter, and cost of manufacture. The closures were grouped under the headings of permanent closures, flanged closures, screwed closures, and Bridgman closures. About a score of different types of closures were described and illustrated.

Symposium on Packed Columns

The last technical session of the meeting was devoted to packed columns, with five papers being presented on such subjects as flooding velocities, Fiberglas as a packing material, and new tower design.

W. A. Bain, Jr., and O. A. Hougen, of the University of Wisconsin, presented



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a paper entitled "Flooding Velocities in Packed Columns;" immediately followed by "Pressure Drop and Flooding Velocity in Packed Towers with Viscous Liquids," by E. M. Schoenborn and W. J. Dougherty, of the University of Delaware. These two papers were so similar in material treated that the discussion was held on both simultaneously.

Bain and Hougen measured flooding velocity on three oils with widely different viscosities, using hydrogen, air, and carbon dioxide, and with five different packings in the tower. The glass construction of the tower permitted visual observation of the actual conditions in the unit under the various operating conditions, and permitted comparison between flooding as defined by the condition causing the upper break in the pressure drop-gas velocity curve, and flooding as defined by visual observation of the actual filling of voids in the packing with liquid.

No direct and reliable correlation could be obtained between the two definitions, although a rough comparison could be made. An equation was presented which fitted the experimental data with an average deviation of ± 6%. Inspection showed that a tower packed with Raschig rings usually flooded from the top packing support upward, while Berl saddles caused flooding in the packing from the bottom packing support upward. Wire helices, however, usually flooded by having slugs of foamy liquid originate at or just above the bottom packing support and move upward through the tower, sometimes to a point well above the top packing support.

Four Packings Used

Schoenborn and Dougherty, using a similar type of equipment, agreed in general with Bain and Hougen, measuring pressure drop and flooding velocities for four commercial packings with air, water and two oils covering a range of kinematic viscosities of from 1 to 38 centistokes. Again a rough, but not exact correlation was obtained between the visual flooding point and the upper break in the pressure drop-gas velocity curve. This paper was supplemented by Kodachrome moving pictures of the tower operating under normal conditions and flooding conditions. In the discussion of these two papers the point was raised regarding the effect of the method of packing the tower, the percentage of voids in the packing and the consequent effect upon the pressure drop and flooding velocity. One author said that repacking the tower in a different way with the same packing did change the pressure drop slightly, but did not affect the flooding velocity.

R. S. Tour and Frank Lerman of the University of Cincinnati presented a paper, "Area Source Liquid Distribution through Unconfined Tower Packing", in which the previously derived equation for liquid distribution through unconfined tower packing from a point source was amplified to include an area source. Specific forms of the equation were presented for a circular source and an annular source.

A relationship between packing height and the distribution constants was confirmed, and values of the packing constants were developed from experimental data. Many typical curves were presented to show the effect of various types of sources, and graphical comparison was made of the curves representing the equation and experimental data for liquid distribution in a tower.

Fiberglas Tested as Packing

George W. Minard, Joseph H. Koffolt, and James R. Withrow of Ohio State University presented a paper, "Fiberglas as a Packing Material for Packed Column Distillation," in which they presented the results of some 600 test runs on the use of commercial Fiberglas as a packing material for distillation. Two towers were used, both 1 ft. in diameter, one packed to a height of 6 ft. and the other to 1.5 ft. The systems used in the investigation were ethanol-water, acetone-water, and methanol-water. The results seemed to indicate that Fiberglas was a promising material for packed column distillation work, having the properties of (1) good rectifying performance, (2) high rate of throughput with low pressure drop, (3) low cost, (4) low hold-up, (5) light weight per unit volume, and (6) consistent behavior.

G. C. Neureuther presented some operating data on a 50-in. diameter column packed with Fiberglas which had been operating at Hiram Walker and Sons, Peoria, Ill. Because of limitations in equipment none of these units has been flooded, the maximum vapor velocity obtained on the experimental column being 6 ft. per second and on the commercial unit being 7 ft. per second. The authors brought out in the discussion of the paper that no sagging or compaction of the packing had been observed in 11 months, and also that the percentage voids in the Fiberglas packing was 97%.

Multi-Tube Column

E. H. Smoker, in his paper, "A High Efficiency Multi-Tubular Packed Column," brought out a design and data on the operation of a batch fractionating column with 7 internal tubes packed individually. The column was 46 ft. high and each of the 7 tubes was 8 in. in diameter. All the tubes were arranged in parallel with a single pot and a single condenser, with the reflux proportioned to each tube. The data presented were for a test mixture of benzene and ethylene dichloride. The proportioning of the reflux was studied in some detail, the efficiency of the installation apparently being changed strongly by any deviation from equally distributed reflux. The multi-tubular arrangement is as efficient as a single tube of corresponding area.

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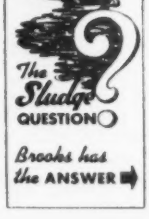

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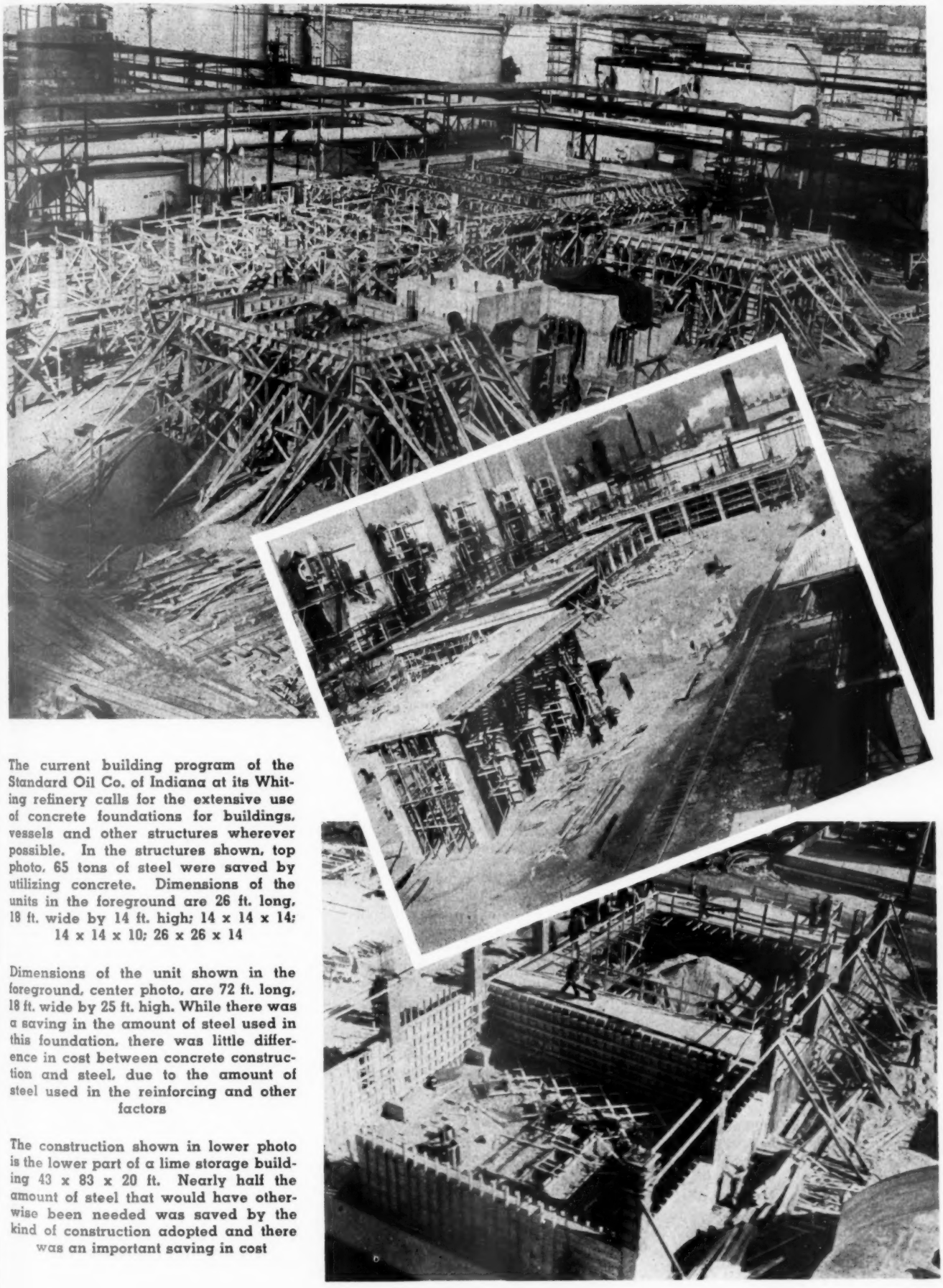

The current building program of the Standard Oil Co. of Indiana at its Whiting refinery calls for the extensive use of concrete foundations for buildings, vessels and other structures wherever possible. In the structures shown, top photo, 65 tons of steel were saved by utilizing concrete. Dimensions of the units in the foreground are 26 ft. long, 18 ft. wide by 14 ft. high; 14 x 14 x 14; 14 x 14 x 10; 26 x 26 x 14

Dimensions of the unit shown in the foreground, center photo, are 72 ft. long, 18 ft. wide by 25 ft. high. While there was a saving in the amount of steel used in this foundation, there was little difference in cost between concrete construction and steel, due to the amount of steel used in the reinforcing and other factors

The construction shown in lower photo is the lower part of a lime storage building 43 x 83 x 20 ft. Nearly half the amount of steel that would have otherwise been needed was saved by the kind of construction adopted and there was an important saving in cost

CYCLING OPERATIONS
and Potential Use of Products*

By James E. Pew**

The cycling plants developed to remove valuable light hydrocarbons from the gas-condensate sands are playing an important wartime role in adding substantially to the supply of aviation gasoline. They are making available supplies of isobutane for alkylate, and it is pointed out that aviation grade naphthas could be made available through cycling for only 28% of the critical materials required to secure an equivalent volume through well head production of crude oil.

With declining crude discoveries it is believed that increasing importance will be given to cycling plant products. A future market is seen for the liquid ethane-propane mixtures now returned to the sand, as gas enrichment agents and possibly for carbon black manufacture and for the production of chemical raw materials.

I HAVE chosen this subject in order that I might emphasize the major role that these operations are today playing in wartime production and will continue to play upon the return of peace. The coming months will see the Paloma cycling plant, in which you are personally interested, placed on stream, adding 7500 bbls. per day to the nation's supply of those light hydrocarbon fractions which are volumetrically equivalent, by virtue of their natural highly refined state, to two or more times their production in terms of crude oil. It is wise, then, to review the state of the industry—to consider briefly the past, but more fully the present and future scope of cycling operations.

It is interesting to note that two Californians, Bruce H. Sage and William N. Lacey, have played an active role in the amassing of knowledge pertinent to this offshoot of the natural gasoline industry. At the request of the American Petroleum Institute, they early undertook a comprehensive study of the complex phenomena associated with retrograde condensation in the reservoir. That investigation, as you know, culminated with the issuance of an authoritative text, "Volumetric and Phase Behavior of Hydrocarbons."

The authors have continued their research, however, on the nation's condensate wealth which today lies essentially in the southwest. In the last decade, condensate field discoveries in that area have risen yearly, reaching a peak of 44% of the total number during the first half of this year. But there are no strict geographic—only geologic—limitations. Such fields have been found in the north, in the Turner Valley field of Canada; in the east, in the Oriskany fields of the Appalachian area; in the Rocky Mountain region, where construction of a cycling plant for the Walden area, embracing the North and South McCallum anticlines of Jackson County, Col., is now under consideration; and on the Pacific Coast, at Kettleman Hills, Paloma, and Helm. Condensate reserves do not appear large in the petroleum wealth of the U. S., representing only about 5% of the total, but they assume Herculean stature through their potential use.

First Plant in 1937

The first plant for cycling gas-condensate production was placed in operation early in 1937 in the Agua Dulce area of South Texas, following what might be termed "pilot plant" operations at the Big Lake field in Texas. Unitization was then slowly building a case for itself, but unit operation for the field was not undertaken. Today four plants are operating at Agua Dulce, but they, through coordination of effort, are effectively removing the increasingly valuable lighter hydrocarbons from the gas-condensate sands. And it is from Agua Dulce and Stratton, both appearing to be major producing problems upon their discovery, that gas, having served its purpose of expelling liquefiables from the reservoir, will be sent to the Appalachian area this coming year and thereafter through a gas-bearing "Big Inch."

In the ensuing six years, cycling plants have passed through stages suggested by the natural gasoline industry—simple separation, stage separation, refrigeration and stage separation—until today the absorption type plant, capable of operating at pressures up to 2000 pounds, is in use almost exclusively. Modern cycling plant design has permitted conversion easily, to embrace technologic advancements as they were made.

With present-day design, cycling plants can function either in complete or partial coordination with refinery operations. When cycling operations are completely coordinated with those at the refinery, the wet gas is processed initially to effect removal of all liquefiables, with extraction efficiencies running as high as 85% on butanes and 99% on the heavier hydrocarbons. The fractions so recovered are then separated into (1) an ethane-propane mixture which may be injected into the producing formation in liquid form; (2) a mixed butane fraction, which is carried to the refinery by pipeline; (3) a fraction containing pentanes plus, which is delivered to the refinery by pipeline or truck; and (4) a residual oil, suitable for use as plant absorption oil.

Varied Operations Practical

It is a plant of the type just described which is currently under construction at the Paloma field, Kern county, Calif. with delivery of products scheduled to the new 100-octane plant of The Texas Co. refinery. It should be noted, however, that this is by no means an inflexible arrangement. Modern cycling plant design readily permits of partial dissociation with the refinery. Through extensions of minor magnitude, plants can be altered for semi-independent operation.

Partially integrated operations are now in common use. In the course of such operations, the ethane-propane mixture may be returned to the formation and the butane fraction transported to the refinery by pipeline, as before. The heavier products, however, are processed to yield a finished grade of fuel, either motor fuel or 87 or 91 octane aviation fuel; while the naphtha (separated when aviation fuel is produced), kerosine, and absorption oil are separated and retained or marketed. Only a minor change in plant operation is required to yield motor fuel or high octane fuels, as desired, again illustrating the extreme flexibility of cycling plant operations. The naphtha yield in the production of high-octane fuels has been found to have a market as charging stock for use in the thermal cracking "quick butadiene" process. Plants in the Agua Dulce-Stratton area of South Texas may be cited as typical of those operating in partial coordination with refineries.

In a modification of this type of operation, the cycling plant may again return the ethane-propane mixture to the producing formation and separate the butane fraction into normal butane and isobutane. The normal butane is then distributable by tank truck in the form of a liquefied petroleum gas, or as a chemical raw material, while the isobutane is delivered to the refinery for alkylation. The heavier fraction is then made to yield motor or 87 or 91 octane fuel, as desired. The disposition of the naphtha, kerosine, and absorption oil produced has earlier been noted. It is evident, then, that the modern cycling plant can be of major importance in today's wartime production, while it is further evident that minor changes in postwar plant operation will make available a steady flow of valuable peacetime products.

The hastening of Allied military operations, with the extension of major operations to two main theaters of war, Euro-

*Presented before California Natural Gasoline Assn., Los Angeles, Nov. 5, 1943.

**Director, Natural Gas and Natural Gasoline Division, Petroleum Administration for War, Washington.

pean and Pacific, has of necessity been accompanied by heightened demands for aviation fuels. Deputy Petroleum Administrator Ralph K. Davies has stated that production of these high octane fuels has increased over 400% since the outbreak of war. The lighter hydrocarbons obtainable through cycling have played a highly significant part in making possible that increase. In a further effort to increase the flow of vital raw materials to refiners for use in the aviation gasoline program, a PAW directive has now been issued prohibiting sale or use of any hydrocarbon mixture containing in excess of 20% by liquid volume of butylene and/or isobutane, for other than aviation gasoline manufacture, synthetic rubber or their components.

Contribute To Aviation Fuel

Cycling operations are fundamental to the success of the aviation fuel program, as they make available a substantial portion of the isobutane which goes into the production of iso-octane alkylate, isopentane, and base stocks. It is accordingly altogether possible to produce a finished 100-octane aviation fuel from raw material derivatives of the cycling plant.

But what of the economic considerations involved in cycling operations? Because of your distance from the center of these operations, PAW Dist. 3, you men of the California natural gasoline industry are probably not overly familiar with such considerations. It may be well to digress momentarily, then, to look at condensate field development as expressed in terms of dollars and cents.

Unitization of condensate fields, which permits of a characteristically conservative development, is capable of yielding returns equally as profitable as those obtained in the closely-spaced competitive development of oil fields. Unitization has long been a stumbling-block in the path of oil and gas conservation, and nowhere more so than in California. Last month E. E. Pyles, chairman of PAW Dist. 5 Production Committee, speaking on "Sources of California's Future Oil Supplies" before the Interstate Oil Compact Commission, stated:

"The principal problem in California . . . is not the technique of recovery but rather the problem of educating our producers and land-owners to the desirability of such procedure and the necessity of unitized or cooperative work as a prerequisite to successful recovery methods. Oil production in this state for the past 25 years has been on a highly competitive basis with most of our fields highly diversified in their surface ownership . . . . Unless, and until our operators are fully conversant with this problem and are willing to throw into the pot their individual properties for the greater reward of increased recovery, little can be accomplished of a substantial nature."

The natural gasoline operator, living on the waste product of the oil operator, has in the past unkindly but perhaps realistically been termed a scavenger. I believe that his physiognomy is today altering in the eyes of the oil industry and that he no longer appears a hungry vulture, but rather a wise old owl. He has played a prime role in making the oil industry conservation-conscious, and today that industry is learning another lesson from him through the efficacy of his unitized cycling operations, doubly necessary in condensate development.

Cycling Plant Potentialities

In wartime, condensate has assumed, through its natural highly refined state, a value superior in many instances to that of crude oil. In this connection, data compiled by the Subcommittee on Aviation Gasoline Potentialities established by PAW Dist. 3's Natural Gas and Natural Gasoline Committee are of interest. It was disclosed that aviation grade naphtha could be made available through cycling operation for only 28% of the critical material expenditure required for well-head production of this valuable fraction in crude oil. Following the extensive study undertaken, the Subcommittee issued three recommendations which indicate fully the potentialities of cycling plant operations. These were:

1. Development of condensate fields for cycling plant operations, including installation of equipment for segregation of components necessary to the aviation fuel program.
2. Increased recovery and segregation of aviation fuel materials through installation of additional facilities in plants now operating.
3. Utilization of components such as ethane-propane mixtures, now being produced but not entering into the war program, for increased production of super aviation fuel.

Some conception of the saving in both critical material and capital in the production of lighter hydrocarbons from condensate fields may be afforded by reference to the recently prepared program determination of the Natural Gas and Natural Gasoline Division of the PAW, which calls for construction capable of yielding an additional 35,000 barrels per day of condensate, natural gasoline and lighter hydrocarbons. The estimated capital investment is $28,800,000, of which $10,800,000 covers the cost of the wells. The expenditure in critical material is estimated at 58,350 tons, of which 28,350 tons will be utilized in these well completions.

The completion of crude oil wells alone for production of an equivalent volume of the light hydrocarbon as found in natural gasoline and condensate would total $55,800,000, while production of an equivalent volume of crude alone would cost $31,500,000. In terms of critical material, expenditures of 216,000 tons and 105,120 tons respectively, would be involved. In terms of processed production and reinjection in condensate fields versus well-head production in oil fields, the latter would cost nearly twice as much, in terms of capital investment, and nearly four times as much in terms of critical materials.

Available Products

Returning to the consideration of cycling plant products, I should like to separate them into four major groups, examining them more or less in order of their availability for utilization. Such a grouping affords:

1. Motor fuels and condensates
2. Butane and pentane fractions
3. Ethane-propane mixtures
4. Dry gas

In the past, base motor fuel and condensate stocks have not appealed too highly to refiners, because of their relatively low volatility and antiknock rating. These factors, although offset to some extent by a high susceptibility to leading, have prompted refiners to reform base fuels from cycling operations into higher octane fuels. On the basis of cost, however, the refiner cannot compete with the cycling plant operator, and satisfactory motor fuels, including leaded grades, can be produced in the field for less than 2.5 cents per gal. With declining crude discoveries and increasing condensate discoveries now the order of the day, increased use of cycling plant fuels may be looked for in the future. The cycling plant operator can readily adapt his operations, at slight cost, to embrace the major technologic advancements of today and tomorrow.

In processing the butane and pentane fractions separately, isomerization, polymerization, hydrogenation, dehydrogenation, and alkylation methods are employed. However, in the production of super fuels and products, no process may be looked upon as being of static design; new methods must be constantly explored with a view toward making more efficient use of these lower-boiling fractions, which promise to be of even greater value in the postwar period. Their potentialities mark them as being among the most valuable of the hydrocarbon fractions.

Future of Ethane-Propane

The large quantities of liquid ethane-propane mixtures presently separated in cycling operations, but returned to the producing horizon in the absence of a market, will find that market with improvement of transportation, storage techniques and chemical development. They bear consideration, in such event, as industrial liquefied petroleum gases. Several other possibilities suggest themselves. First, they are potentially useful as manufactured gas enrichment agents, and, second, inasmuch as it has been proved possible to produce carbon black from liquid hydrocarbons, and since higher yields have been noted with higher ethane content of fuels used, they would appear to be of potential importance in the production of this necessary item, in the manufacture of which

11% of the nation's total gas consumption was utilized this past year.

Again, with the development of modern methods of regenerative cracking, cycling products are available for the production of such chemical raw materials as acetylene, ethylene, propylene, butadiene and benzene. Generally speaking, today's super war products are synthesized from chemically active unsaturated hydrocarbons such as these, either produced or producible with cycling products as basic constituents. Ethylene and propylene so obtained afford unsaturates of prime value in the production of, respectively, neohexane and cumene. In combination with benzene, ethylene may also yield styrene, a principal component of Buna S rubber. By rearrangement or recombination, hydrocarbons obtainable in the cycling plant can provide the raw materials for any of the five basic types of synthetic rubber from which airplane and other tires, innerseal semi-solids for gasoline tanks and tubes, and other products of diversified nature may be derived.

When all liquefiable hydrocarbons have been removed from the condensate reservoir, 85-90% of the original gas content will still be contained therein if maximum production has been obtained through reinjection of residue gas. This dry gas, having performed its initial task of expelling liquefiables from the reservoir, is then available for use as fuel, for gas lift or repressuring in another field or another horizon, or for conversion into useful products.

Of Growing Potential Value

Rapid developments in petroleum chemistry, particularly since 1930, have shown that natural gas will react when activated by the effects of heat, pressure, chemical reagents, and light; and that these reactions can be made to proceed at practicable conditions, especially if catalysts are employed. As these results became known, the possibility of a synthetic organic chemical industry based upon these reactions became apparent, and today this industry is large and growing rapidly. It would require a volume to set forth all the potential uses of natural gas and that volume would be obsolescent prior to completion. As Dr. Gustav Egloff, our foremost hydrocarbon protagonist, has so ably said:

" . . . . if we start with methane gas alone, all of the known synthetic products that man has produced in organic chemistry can be derived . . . Any synthetic product can be produced at a price; the hydrocarbons are all potentially available to be converted into the manifold products that man requires in a modern world."

Thus the natural gas being reinjected and stored for future use becomes of increased value with each technologic advance. As an example, today in wartime, synthetic ammonia continues to find itself an important base material in the production of munitions. In the production of synthetic ammonia the most difficult and expensive ingredient to obtain is hydrogen. Today approximately 50% of the emergency synthetic ammonia is manufactured with hydrogen derived from natural gas with a great saving in investment, time and critical materials.

One of the outstanding potential uses of dry natural gas is the synthesis of liquid hydrocarbon fractions by means of a process commonly referred to as the Fischer-Tropsch process. The production of motor fuel by means of this process, in this event making use of a solid fuel (coal or coke) is now in commercial use in Germany. It is interesting to note that an estimated 50% of Western Axis oil is obtained through synthesis, and that the aviation fuel derivative reportedly will bear favorable comparison with our high octane products. With natural gas as the raw material, three steps are involved: reforming to water gas (hydrogen and carbon monoxide), synthesis into liquid hydrocarbon fractions, and finally recovery and separation. The three steps are already being practiced separately on a commercial scale, and in all likelihood a combination commercial installation will be realized in the near future. Gasoline, fuel oil, and heavy oil will thereby be made available under favorable economic conditions to augment our declining petroleum resources.

Oxygen is today being introduced into the hydrocarbon molecule on a commercial scale, but the mixture of products so obtained makes recovery and separation difficult. A process should be available in the near future, however, whereby natural gas may be converted into formaldehyde, with a high degree of purity. Through this process, natural gas will become available to the expanding plastics industry.

Of the total current 240,000 barrels daily of natural gasoline and cycling plant products, it is estimated that one-fourth is produced in cycling operations. Plants now being constructed—among them the Paloma plant—will materially add to the present cycling plant production, while additional construction programmed by the PAW Natural Gas and Natural Gasoline Division for completion by the end of next year will result in cycling plant production approaching 40% of the total production of natural gasoline and allied products. Such operations are, then, obviously destined to play an ever increasing part in the recovery and utilization of the lighter hydrocarbon fractions, both in the war and postwar periods.

It is not possible to prophesy the exent of the role which cycling operations will play in future developments in California. But no matter how important hey may become, I am assured that the nen in your natural gasoline industry will fill that role capably.

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OIL PRICES Do Change

Even though oil prices are limited by Government ceilings, there have been price changes somewhere many times each week . . . . On the East Coast, for instance, there were 62 price changes during the last 34 weeks.

The explanation for this is that the Government only puts a "roof" on prices, it does not "fix" prices . . . . Therefore, prices can be, and often are changing BELOW Government ceiling prices . . . They can, and sometimes do, cost the buyer more than the ceilings because of many extras which new war conditions have imposed on the refiners.

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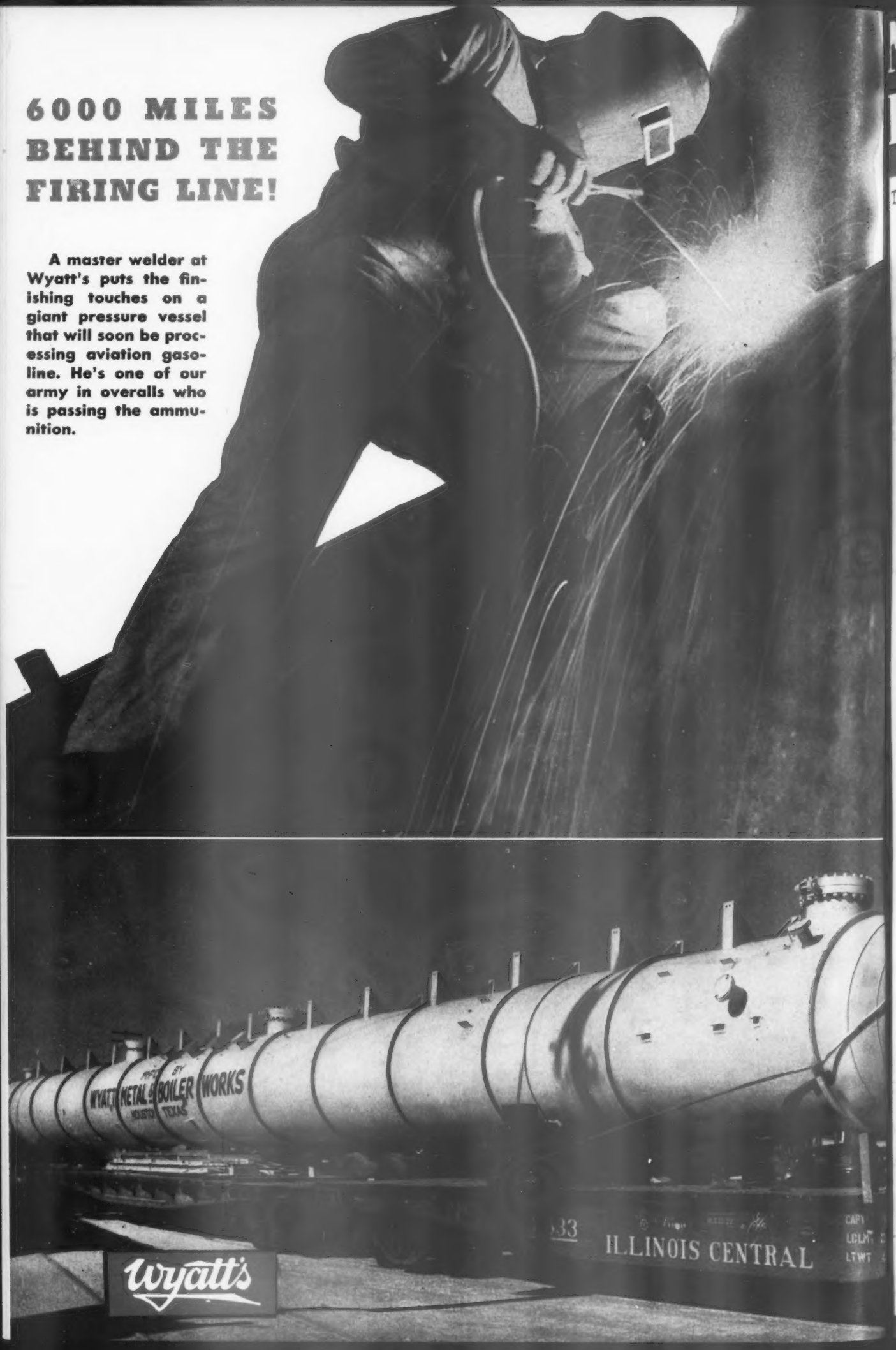
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